PHILIPS

Portable dual-trace oscilloscope

PM 3260(E)
PM 3261

9499 440 19302

790125/2/07/08E

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Instruction manual

Portable dual-trace oscilloscope
Tragbarer Zweistrahl-Oszillograf
Oscilloscope double trace portatif

PM3260 (E)
PM3261

PHILIPS

Order no. of
this manual

9499 440 19302

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Operating manual

1. General information

1.1. INTRODUCTION

The PM 3260 Portable oscilloscope enables the measurement of signals at a high sensitivity (5 mV/DIV) over a large bandwidth (120 MHz). The oscilloscope is provided with many thin-film circuits which guarantee a very stable operation and reduce the number of adjusting points.

There is a wide choice of display possibilities, such as one channel, two channels alternately or chopped, two channels added, with normal and inverted positions for both input signals, and a main and delayed time-base.

The PM 3260 oscilloscope features a tapless power supply with low dissipation. This power supply works on any a.c. voltage between 90 V and 264 V, thus obviating the need of adjusting the instrument to the local mains voltage.

All these features make the oscilloscope suitable for a wide variety of applications.

The PM 3260E oscilloscope is a similar instrument, but without calibrated delay-time multiplier knob and probe-power supply.

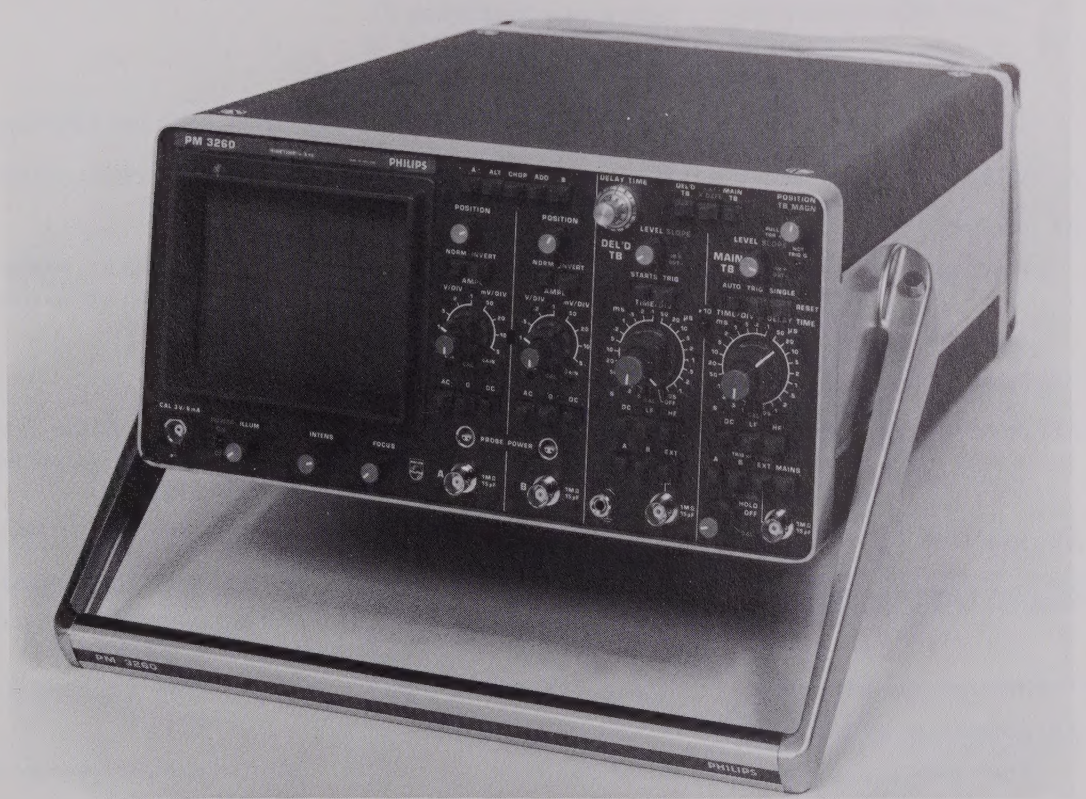

Fig. 1.1. Portable dual-trace oscilloscope PM 3260

1.2. CHARACTERISTICS

This specification is valid after the instrument has warmed up for 15 minutes. Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average instrument.

Designation		Specification	Additional information
1.2.1.	C.R.T.		
	Type	PHILIPS D14-240	Rectangular tube face, domed mesh type, post-accelerator, metal-backed phosphor
	Measuring area	80 mm x 100 mm	
	Screen type	P31 (GH) phosphor	P7 (GM) phosphor optional
	Photographic writing speed	> 1500 cm/μs	Measured with Steinheil Oscillophot M5 camera. Aperture: 1:1,2 Object to image ratio: 1:0,5 Film: Polaroid 410 (10000 ASA) No pre-fogging Phosphor type P31 (GH)
	Total acceleration voltage	20 kV	
	Graticule	Internal	Continuously variable illumination
	Engravings	Centimetre divisions with sub-divisions of 2 mm along the central axes. Dotted lines indicate 10 % and 90 % of measuring lattice for measurement of rise time	
1.2.2.	VERTICAL OR Y AXIS		
1.2.2.1.	*Response*		
	Frequency range	d.c. ... 120 MHz 10 Hz ... 120 MHz	-3 dB bandwidth d.c. coupled -3 dB bandwidth a.c. coupled
	Rise time	≈ 3 ns	
	Pulse aberrations	± 3 % (4 % peak-to-peak)	
1.2.2.2.	*Deflection coefficients*	5 mV/DIV ... 2 V/DIV	Nine calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1 : $\geqslant 2,5$
1.2.2.3.	*Error limit*	± 3 %	
1.2.2.4.	*Max. permissible input voltage*	± 400 V 800 $V_{p\text{-}p}$ a.c.	d.c. + a.c. peak. Up to 20 mV position of input attenuator derating at frequencies over 500 kHz. See Fig. 1.2.
1.2.2.5.	*Instability of the spot position*		
	Trace jump	$< 0,3$ Div	When switching between any of the attenuator positions
	Trace jump	$< 0,3$ Div	When switching the NORM/INVERT switch
	Trace shift	$< 0,3$ Div	When rotating the continuous attenuator
	Trace shift	< 1 Div	When switching to the ADDED position
	Temperature drift	$< 60\ \mu V/^oC$	Typical value

Designation	Specification	Additional information
1.2.2.6. Maximum deflection		
Undistorted	24 divisions	
Shift range	16 divisions	8 divisions each in topward and downward direction reckoned from the central horizontal graticule line
1.2.2.7. Input impedance	1 MOhm//15 pF	
1.2.2.8. Input RC time	⩾ 17 ms	Coupling switch to AC
1.2.2.9. Visible signal delay	Approximately 30 ns	
1.2.2.10. Display modes	Channel + or −A only Channel + or −B only Channels ±A and ±B chopped Channels ±A and ±B alternate Channels ±A and ±B added	
1.2.2.11. Chopper frequency	≈ 1 MHz	
1.2.2.12. Cross-talk between channels	1 : 500	2 divisions of signal amplitude at 50 MHz on one channel set to .2 V/DIV. Cross-talk is measured on other channel set to 20 mV/DIV
1.2.2.13. Common-mode rejection factor	100 at 100 kHz 100 at 2 MHz 20 at 50 MHz	Measured with +A and −B added; max. common mode signal 8 divisions
1.2.3. HORIZONTAL OR X AXIS		
1.2.3.1. Display modes	– Main time base – Main time base intensified by delayed time base – Delayed time base – XY Operation	X deflection by: – Channel A signal – Channel B signal – Signal applied to EXT connector of main time base – Mains frequency
1.2.4. MAIN TIME BASE		
1.2.4.1. Operation	Triggered Automatic Single shot	Possibility of automatic free-running in the absence of triggering signals
1.2.4.2. Time coefficients	1 s/Div ... 50 ns/Div	Twenty-three calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1 : ⩾ 2,5 between the steps
1.2.4.3. Coefficient error	±2 % ±3 %	+20 °C ... +30 °C +5 °C ... +40 °C Sweep accuracy over any two divisions of 10 DIV sweep is ±5 %. Exclude the first and last DIV at the 5 ns and 10 ns magnified sweep rates.

Designation	Specification	Additional information
1.2.4.4. Expansion		
Magnification	10x	Switched, calibrated
Additional error	±1 %	First and last 50 ns of 5 ns, 10 ns and 20 ns magnified sweep rates excluded.
Max. effective time coefficient	5 ns/Div	
1.2.4.5. Variable hold-off time	The sweep hold-off time can be increased by approx. a factor of 10	
1.2.5. DELAYED TIME BASE		
1.2.5.1. Operation	Delayed time base starts at option either immediately after the delay time, or upon arrival of the first trigger pulse after the delay time	
1.2.5.2. Time coefficient	0,5 s/DIV ... 50 ns/DIV	Twenty-two calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1 : ⩾ 2,5 between the steps
1.2.5.3. Coefficient error	±2 % ±3 %	+20 °C ... +30 °C +5 °C ... +40 °C Sweep accuracy over any two divisions of 10 DIV sweep is ±5 %. Exclude the first and last DIV at the 5 ns and 10 ns magnified sweep rates.
1.2.5.4. Delay time	Continuously variable between 0x and 10x the time coefficient of the main time base	Calibrated in the standard model PM 3260. Range delay-time multiplier 0,00 - 9,99. Incremental accuracy 0,5 %; typical 0,2 %. Not calibrated in the PM 3260E model.
1.2.5.5. Delay-time jitter	< 1 : 20 000	Typical value 1 : 30 000
1.2.6. X DEFLECTION		
X Deflection via channel Y_A		
1.2.6.1. Deflection coefficient	5 mV/DIV ... 2 V/DIV	Uncalibrated continuous control 3:1 via X AMPL potentiometer
1.2.6.2. Coefficient error	±5 %	
1.2.6.3. Bandwidth	0 ... 2 MHz	−3 dB bandwidth over 8 DIV
1.2.6.4. Input impedance	1 MOhm//15 pF	
1.2.6.5. Phase difference	3° at 100 kHz	
X-Deflection via channel Y_B		
Same as for X-deflection via Y_A channel, but with a coefficient error of ± 20 %.		
External X deflection via EXT socket		
1.2.6.6. Deflection coefficient	300 mV/DIV	One calibrated position. Uncalibrated continuous control ⩾ 3:1.
1.2.6.7. Bandwidth	0 ... 2 MHz	−3 dB bandwidth over 8 DIV

Designation	Specification	Additional information
1.2.6.8. Input characteristics	Identical to Y channels	
1.2.6.9. Phase difference	3^{o} at 100 kHz	

X Deflection with internal voltage at mains frequency

The deflection depends on the mains voltage and has been factory-adjusted to 8 DIV at a mains voltage of 220 V.

1.2.7. TRIGGERING OF THE MAIN TIME BASE

1.2.7.1. Source	Internal from channel A Internal from channel B Internal from mains External source	
1.2.7.2. Mode	Automatic	Automatic free-run of the time-base generator approx. 100 ms after disappearance of the trigger signal.
	Manual level Single sweep	
1.2.7.3. Slope	+ or –	
1.2.7.4. Sensitivity	Internal ⩽ 0,5 DIV External ⩽ 150 mV	Typical sensitivity as a function of frequency, see Fig. 1.3.
1.2.7.5. Filter bandwidth	DC: 0 - 120 MHz	Flat response, both internal and external
	LF: 0 - 30 kHz	–3 dB, internal
	LF: 10 Hz - 30 kHz	–3 dB, external
	HF: 30 kHz - 120 MHz	–3 dB, both internal and external
1.2.7.6. Level range	24 DIV –3,6 V to +3,6 V	at internal trigg. at external trigg.
1.2.7.7. Input characteristics	Identical to Y channels	

1.2.8. TRIGGERING OF THE DELAYED TIME BASE

1.2.8.1. Source	Internal from channel A Internal from channel B External	

Other characteristics are identical to TRIGGERING OF THE MAIN TIME BASE.

1.2.9. CALIBRATION UNIT

1.2.9.1. Output voltage	3 V_{p-p}	
1.2.9.2. Output current	6 mA	
1.2.9.3. Error limit	±1 %	Both voltage and current
1.2.9.4. Frequency	2 kHz < 2 %	
1.2.9.5. Protection	The output is protected against continuous short-circuits	

Designation	Specification	Additional information
1.2.10. POWER SUPPLY		
1.2.10.1. Mains voltages	Any voltage between 100 and 240 V ±10 % in one range	
1.2.10.2. Mains frequency	46 to 440 Hz	
1.2.10.3. Probe power	+ and −24 V	Not provided on PM 3260E model
1.2.10.4. Power consumption	45 W	
1.2.11. ENVIRONMENTAL CAPABILITIES		
1.2.11.1. Ambient temperature	+5 °C ... +40 °C −10 °C ... +55 °C −40 °C ... +70 °C	Rated range of use Limit range of operation Storage and transport conditions
1.2.11.2. Altitude	5 000 m 15 000 m	Operating Not operating
1.2.11.3. Humidity	The instrument meets the requirements of the IEC 50 B (CO) 142 recommendations	
1.2.11.4. Shock	The instrument meets the requirements of the IEC 68 Eb recommendations	
1.2.11.5. Vibration	The instrument meets the requirements of the IEC 68 F recommendations	
1.2.11.6. Recovery time	15 minutes for normal operation	Coming from −10 °C and going to +20 °C at 60 % relative humidity
1.2.12. MECHANICAL DATA		
1.2.12.1. Dimensions	Length 410 mm (16 1/4") Width 316 mm (12 1/4") Height 154 mm (6 1/8")	Excl. controls, cover and feet
1.2.12.2. Weight	9,3 kg (20.5 lbs)	

1.2.13. ACCESSORIES

1.2.13.1. Accessories delivered with the instrument

Two contrast filters
Front cover with storage space
Collapsible viewing hood PM 9366
Banana - BNC adapter PM 9051
CAL terminal - BNC adapter
Manual

1.2.13.2. Optional accessories

PM 9335	Passive 1:1 probe
PM 9351	Passive 10:1 probe
PM 9358	Passive 100:1 high-voltage probe
PM 9347*)	Active t.v. probe
PM 9352*)	Active microminiature probe
PM 9353*)	Active F.E.T. probe
PM 8960	Rack-mounting adapter
PM 8971	Camera flange
PM 9380	Oscilloscope camera
	Oscilloscope camera range Steinheil Oscillophot

*) Auxiliary Probe Power Supply PM 9346 is necessary if these probes are to be used with the PM 3260E model.

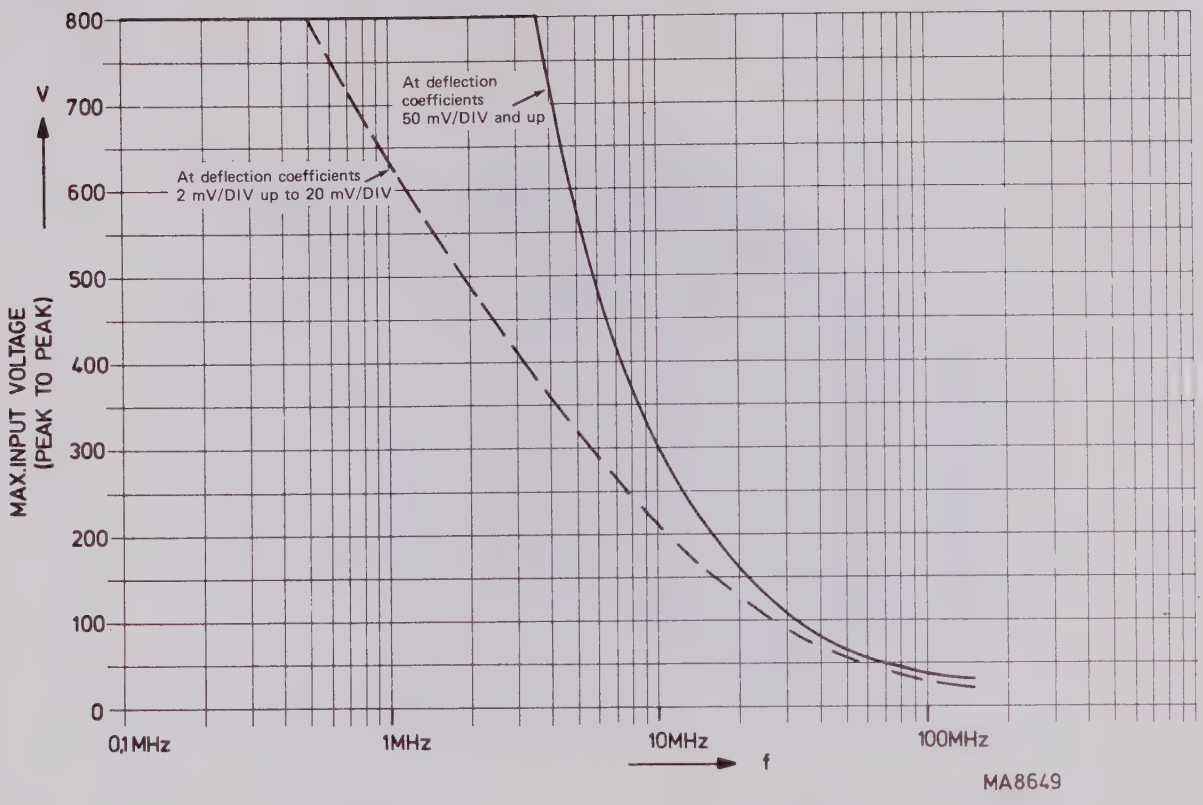

Fig. 1.2. Derating of the maximum permissible input voltage as a function of frequency

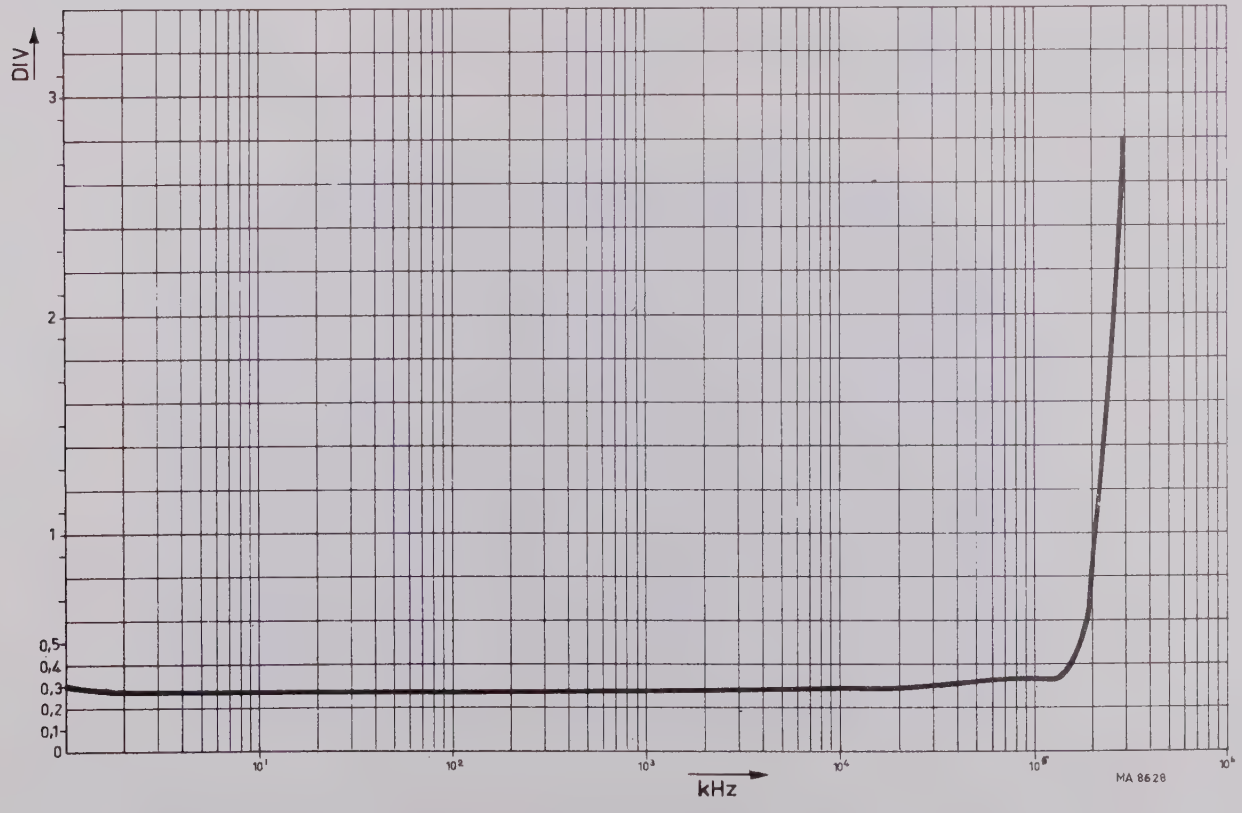

Fig. 1.3. Typical trigger sensitivity of channel A as a function of frequency

Fig. 2.1. Removing front cover

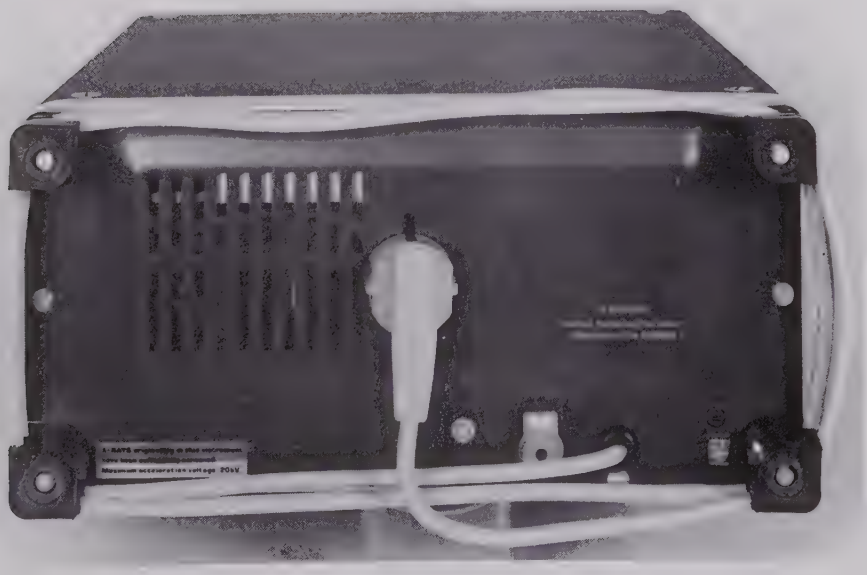

Fig. 2.2. Rear view of the instrument

2. Directions for use

2.1. INSTALLATION

2.1.1. Removing and fitting the front cover

Removing: – Turn the knob in the centre of the cover a quarter of a turn anti-clockwise to position UNLOCKED.
– Take the cover off.

Fitting: – Turn the knob to the UNLOCKED position.
– Fit the cover over the front of the oscilloscope.
– Press the knob and turn it a quarter of a turn clockwise to the LOCKED position.

Remark: The handle can be rotated if the push-buttons on its bearings are depressed.

Warning: This instrument generates high voltages and should not be operated with the cabinet plates removed. The mains plug must be removed before attempting any maintenance work, and any relevant high-voltage points discharged.

2.1.2. Mains adjustment and fuse

The ability of the instrument to operate at any mains voltage between 90 and 264 Va.c., obivates the need of adaptation to the local mains voltage.
The fuse holder which is mounted on the rear panel carries a 2 A delayed action fuse. The use of repaired fuses and the short-circuiting of fuse holders is prohibited.

2.1.3. Earthing

In the interests of safety, the oscilloscope must be connected to earth via the rear earthing terminal (identified by the symbol ⏚) or via the mains lead, provided that the supply socket is equipped with an earth connection. Care must be taken that the earth line to the oscilloscope is not interrupted due to the use of an extension lead or device which is not fitted with an earth conductor.

2.1.4. Switching on

The POWER switch is incorporated in the graticule ILLUMination control on the front panel, immediately below the screen bezel. The oscilloscope must never be switched on whilst any circuit board or block has been removed.
Never remove a circuit board or block until at least one minute after the oscilloscope has been switched off.

2.2. OPERATING INSTRUCTIONS

Before switching on, ensure that the oscilloscope has been correctly installed in accordance with section 2.1. INSTALLATION and that the precautions outlined have been observed.

2.2.1. Controls and sockets (Fig. 2.3.)

2.2.1.1. Vertical channels

A/ALT/CHOP/ADD/B	Display-mode controls; 5-way push-button switch.
A depressed	Vertical deflection is achieved by the signal connected to the input of channel A.
ALT depressed	The display is switched over from one vertical channel to the other at the end of every cycle of the time-base signal.
CHOP depressed	The display is switched over from one vertical channel to the other at a fixed frequency.
ADD depressed	Vertical deflection is achieved by the sum signal of channels A and B.
B depressed	Vertical deflection is achieved by the signal connected to the input of channel B. If no push-button is depressed, the instrument operates in the ALT mode.
POSITION	Continuously variable control giving vertical shift of the display.
NORM/INVERT	2-Way push-button switch for the inversion of the signal polarity. No push-button depressed has the same effect as the NORM button depressed.
AMPL.	Step control of the vertical deflection coefficients; 9-way switch.
AMPL./CAL. (blue)	Continuously variable control of the vertical deflection coefficients. In the CAL. position the deflection coefficient is calibrated.
BAL (screw-driver operated)	Continuously variable control of the direct voltage balance of the vertical amplifiers.
GAIN (screw-driver operated)	Continuously variable control of the overall gain of the vertical channels.
AC/0/DC	Signal coupling; 3-way push-button switch.
AC depressed	Coupling via a blocking capacitor
0 depressed	Connection between input circuit and input socket is interrupted and the amplifier input is earthed
DC depressed	Direct coupling No button depressed has the same effect as the AC button depressed.
A 1 MOhm - 15 pF	BNC input socket for channel A
B 1 MOhm - 15 pF	BNC input socket for channel B

2.2.1.2. Horizontal channel

DEL'D TB - EXT. X DEFL - MAIN TB	Horizontal-deflection controls; 3-way push-button switch.
DEL'D TB depressed	The horizontal deflection voltage is supplied by the delayed time-base generator.
EXT. X DEFL depressed	Horizontal deflection is achieved by an external signal applied to the input socket of the horizontal amplifier, by the channel A signal, by the channel B signal or by a mains-frequency signal.

MAIN TB depressed

The horizontal deflection voltage is supplied by the main time-base generator.
A part of the trace is intensified (except in position OFF of the TIME/DIV switch of the delayed time-base generator).
No button depressed has the same effect as the MAIN TB button depressed.

POSITION
TB MAGN

Continuously variable control giving horizontal shift of the display; incorporates a push-pull switch which increases the horizontal deflection coefficient by a factor 10. A pilot lamp labelled x10 lights up when the magnifier is in operation.

X AMPL/HOLD OFF

Continuously variable control of the horizontal deflection coefficients in case of external X deflection.
In case of X deflection by the main time base, this control can be used to increase the sweep hold-off time.

2.2.1.3. Main time-base generator

LEVEL

Continuously variable control to select the level of the triggering signal at which the time-base generator starts.
This control incorporates a push-pull switch which enables choice of triggering on the positive- or negative-going edge of the triggering signal.

NOT TRIG'D

Pilot lamp which lights up when the time-base generator is in waiting position.

AUTO - TRIG - SINGLE

Trigger-mode controls; 3-way push-button switch.

AUTO depressed

The main time-base generator is free-running in the absence of triggering signals.

TRIG depressed

The time-base generator is normally triggered.

SINGLE depressed

After operating the SINGLE button, the time-base generator runs only once upon receipt of a trigger pulse.
If no button is depressed, the instrument operates in the SINGLE mode.

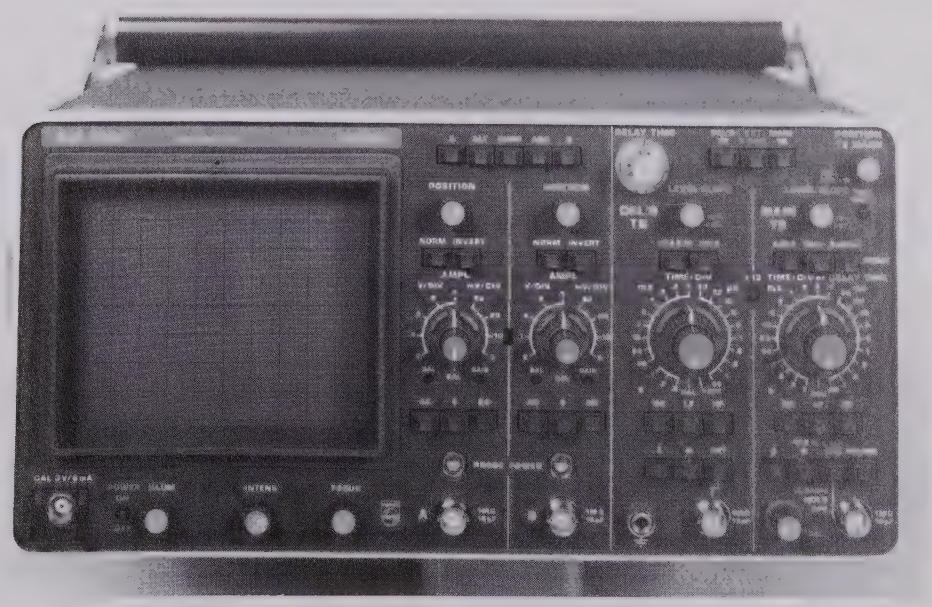

Fig. 2.3. Front view of the instrument

TIME/DIV or DELAY TIME	Time-coefficient control of the main time-base; 23-way rotary switch.
TIME/DIV - CAL (blue)	Continuously variable control of the time coefficient of the main time-base. In the CAL position the time coefficient is calibrated.
DC - LF - HF	Trigger coupling; 3-way push-button switch.
DC	Triggering signals are direct-coupled.
LF	Coupling via low-pass filter for frequencies up to 30 kHz (for external triggering via band-pass filter of 10 Hz - 30 kHz).
HF	Coupling via a high-pass filter for frequencies higher than 30 kHz. No push-button depressed has the same effect as button DC depressed.
TRIG or X DEFL	Trigger source or external X deflection selector; 4-way push-button switch.
A	Internal triggering or X deflection signal derived from channel A.
B	Internal triggering or X deflection signal derived from channel B.
EXT	Triggering on external signal connected to the adjacent 1 MOhm-15 pF socket. When the EXT X DEFL button of the horizontal deflection controls is depressed, this socket is connected to the input of the horizontal amplifier.
MAINS	Triggering or X deflection signal derived from an internal voltage with the mains frequency. No push-button depressed has the same effect as button A depressed.
1 MOhm - 15 pF	BNC socket for external triggering or horizontal deflection.

2.2.1.4. Delayed time-base generator

DELAY TIME MULTIPLIER	Continuously variable control of the delay time, operating together with the TIME/DIV controls of the main time-base generator.
LEVEL SLOPE	Continuously variable control to select the level of the triggering signal at which the delayed time-base generator starts. This control incorporates a push-pull switch which enables choice of triggering on the positive- or negative-going edge of the triggering signal.
STARTS - TRIG	Choice of the starting point of the delayed time-base generator after the delay time; 2-way push-button switch.
STARTS	The delayed time-base generator is started immediately after the delay time.
TRIG	The delayed time-base generator starts after the delay time upon receipt of a trigger pulse. No push-button depressed has the same effect as the STARTS button depressed.
TIME/DIV	Time-coefficient control of the delayed time-base; 23-way rotary switch. Incorporates an OFF position in which the delayed time-base generator is switched off.
TIME/DIV - CAL (blue)	Continuously variable control of the time coefficient of the delayed time-base generator. In the CAL position the time coefficient is calibrated.

DC - LF - HF	Trigger coupling; 3-way push-button switch.
DC	Triggering signals are direct-coupled.
LF	Coupling via low-pass filter for frequencies up to 30 kHz (for external triggering via band-pass filter of 10 Hz to 30 kHz).
HF	Coupling via a high-pass filter for frequencies higher than 30 kHz. No button depressed has the same effect as the DC button depressed.
A - B - EXT	Trigger source control; 3-way push-button switch.
A	Internal triggering signal derived from channel A.
B	Internal triggering signal derived from channel B.
EXT	Triggering on an external signal connected to the adjacent 1 MOhm-15 pF socket. No button depressed has the same effect as the A button depressed.
1 MOhm - 15 pF	BNC input socket for external triggering signal.

2.2.1.5. Cathode-ray tube

ILLUM POWER	Continuously variable control of the graticule illumination; incorporates mains switch. Pilot lamp indicates the ON state.
INTENS	Continuously variable control of the trace brilliance.
FOCUS	Continuously variable control of the electron-beam focusing.

2.2.1.6. Miscellaneous

CAL	Output socket on which a square-wave voltage of 3 $V_{p\text{-}p}$ and a current of 6 mA at a frequency of 2 kHz are available. Amplitude accuracy: ±1 %. Frequency accuracy: ±2 %. The output is protected against continuous short-circuits.
PROBE POWER	Power socket for active accessories; supplies +24 V and −24 V.
⏚	Measuring-earth socket

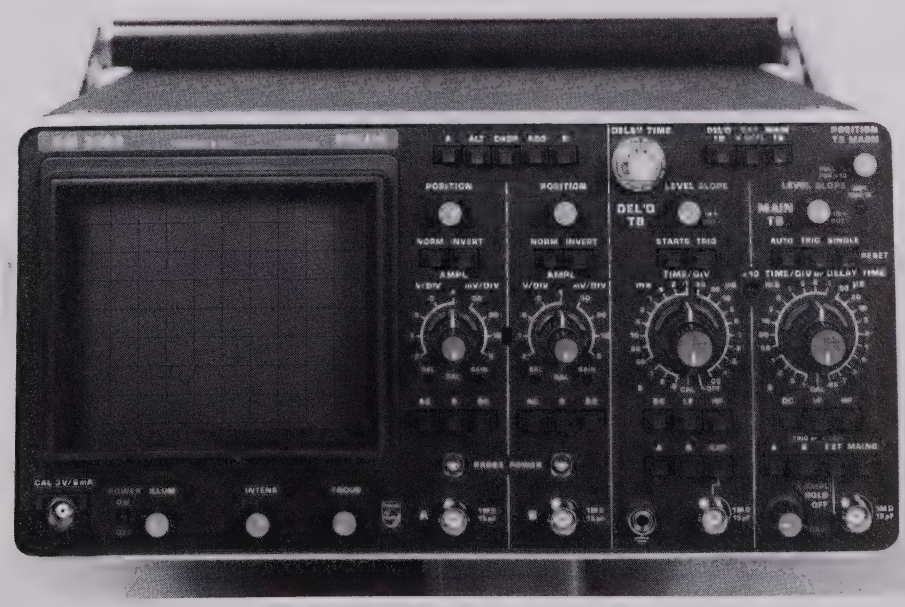

Fig. 2.3. Front view of the instrument

2.2.2. Preliminary settings

As the following settings are identical for both vertical channels, only the procedure for channel A has been indicated.

2.2.2.1. Adjusting the d.c. balance

- Operate push-button A of the display-mode controls.
- Operate push-button AUTO of the trigger-mode controls.
- Operate push-button MAIN TB of the horizontal deflection controls.
- Set the AMPLitude switch to 5 mV and the continuous control to CALibrated.
- Centre the trace with the POSITION controls.
- Set the INTENSity and FOCUS controls for a sharp, well-defined trace.
  The controls not mentioned may occupy any position.
- Check that the trace does not jump when the AMPL switch is switched between the 5 and 10 mV positions.
  If necessary, readjust the BALance control on the front panel immediately below the AMPLitude control.

2.2.2.2. Adjusting the gain

Unless otherwise stated, the controls occupy the same position as in the previous adjusting procedure.

- Set the AC-0-DC switch to DC.
- Set the AMPLitude switch to .5 V and the continuous control to CALibrated.
- Connect the CALibration socket to the A input socket.
- Check that the trace height is exactly 6 divisions.
  If necessary, readjust the GAIN control on the front panel, immediately below the AMPLitude switch.

2.2.3. Inputs A and B and their possibilities

The oscilloscope has been provided with two identical channels, each of which can be used for either YT measurements in combination with one or both time-base generators, or XY measurements in combination with the external horizontal channel.

2.2.3.1. YT Measurements

To display one signal, either of the two vertical channels can be selected by operating either push-button A or push-button B of the display-mode controls.
When push-button ALT or CHOP is depressed, two different signals can be displayed simultaneously. The Y deflection coefficient and the polarity can be selected for each channel individually. When the ALT button is operated, the display is switched over from one channel to the other at the flyback of the time-base signal. Although the ALTERNATE mode can be used at all sweep speeds of the time-base generator, the CHOPPED mode will give a better display quality for long sweep times, because during these long sweep times the alternate display of the two input signals is clearly visible to the eye.

In the CHOPPED mode, the display is switched over from one channel to the other at a fixed frequency.
If push-button ADDED of the display-mode switch is operated, the signal voltages of both vertical channels are added. Depending on the positions of the polarity switches, either the sum or the difference of the input signals is displayed. The ADDED mode also enables differential measurements. With these measurements advantage is taken from the common mode rejection in the ADDED position. When the polarity switches of both channels are set to opposite positions, the common mode parts of the signals on sockets A and B will undergo a very slight amplification only, with respect to the differential mode parts.

2.2.3.2. XY Measurements

If push-buttons EXT X DEFL of the horizontal-deflection controls and A of the TRIG OR X DEFL controls are operated, the time-base generators are switched off. A signal applied to the vertical A channel is then used for horizontal deflection. The AC/0/DC switch and the step attenuator of channel A remain operative. Continuous control of the deflection coefficients is possible with the X DEFL/HOLD OFF control and horizontal trace shift with the X POSITION control.

Vertical channel B may also be used for X deflection.
To this end, the B button of the TRIG OR X DEFL controls is depressed.

It is also possible to use an internal voltage at the mains frequency or a signal applied to the EXT socket at the bottom right-hand side of the front panel for X deflection, after depressing the relevant push-button of the TRIG OR X DEFL controls. In these modes the trace width can be controlled with the X DEFL/HOLD OFF potentiometer.
With this potentiometer in its CAL position, the deflection coefficient for external signals is 300 mV/DIV.
The external signal can be either d.c. or a.c. coupled (lower frequency limit 10 Hz) by depressing either the DC or the LF push-button of the trigger coupling controls of the main time-base.

2.2.3.3. AC/0/DC switch

The signals under observation are fet to input socket(s) A and/or B and the AC/0/DC switch is set to either AC or DC, depending upon the composition of the signal. As the vertical amplifier is d.c. coupled, the full bandwidth of the instrument is available and d.c. components are displayed as trace shifts in the DC position of the AC/0/DC switch.
This may be inconvenient when small signals superimposed on high d.c. voltages must be displayed. Any attenuation of the signal will also result in attenuation of the small a.c. component. The remedy is to use the AC position of the input switch, which employs a blocking capacitor, to suppress the d.c. and l.f. signals.
Some pulse droop will occur when l.f. square-wave signals are displayed.

The 0 position interrupts the signal and earths the amplifier input for quickly determining the 0 V level.

2.2.4. Triggering

If a signal must be displayed, the horizontal deflection must always be started on one fixed point of the signal in order to obtain a stationary display. The time-base generator is, therefore, started by narrow trigger pulses formed in the trigger unit and controlled by a signal originating from one of the vertical input signals, an internal voltage at mains frequency or an external source.

2.2.4.1. Trigger coupling

Three different trigger-coupling methods can be chosen with the DC/LF/HF switch. In the HF and LF positions, the transfer characteristic is limited.
In position DC the trigger signal is passed unchanged.
In position LF, a 0 Hz (10 Hz for external triggering) to 30 kHz band-pass filter is inserted. This position can be used to reduce interference from noise.
In position HF, a 30 kHz high-pass filter is inserted.
This position can be used to reduce interference from e.g. hum.

2.2.4.2. Selecting the trigger source and setting the trigger level

The trigger signal is obtained from channel A (button A depressed), channel B (button B operated), an external source (button EXT depressed) or from an internal voltage at mains frequency (button MAINS depressed).
The trigger pulse shaper is a dual-controlled multivibrator switched by the output signals of a differential amplifier.
The trigger signal, which is not affected by the continuous AMPLitude control is, together with direct voltages which are adjustable with the LEVEL potentiometer, fed to the inputs of the differential amplifier.
Depending on the LEVEL setting, a certain part of the trigger signal will be amplified by the differential amplifier.
The multivibrator is thus switched at a fixed point of the trigger signal (see Fig. 2.4.). This means that, with the aid of the LEVEL control, it is possible to scan the shape of the trigger signal (in case of internal triggering A or B equal to the shape of the signal to be displayed) and, thus, to choose the point where the multivibrator will be switched.
The LEVEL potentiometer is fitted with a push-pull switch which allows selection of the trigger slope.

2.2.4.3. Automatic triggering

When the AUTOmatic button of the AUTO-TRIG-SINGLE switch is operated, and if there are no trigger pulses available, the time-base generator is automatically free-running.
The trace is, therefore, always visible. The AUTOmatic mode can be used in all cases where also the TRIG mode is usable, except with signal frequencies lower than 10 Hz or pulse trains with an off time exceeding 100 ms.
As soon as trigger pulses are available, the free-running state of the time-base generator is automatically terminated and the time-base generator is triggered again as described in sections 2.2.4.1. and 2.2.4.2.
When the TRIGgered or SINGLE button is operated, the auto-circuit is switched off. The LEVEL setting can also be used in the AUTOmatic mode.

2.2.4.4. SINGLE sweep triggering

When effects which occur only once have to be observed (usually photographed), it is often desirable to ensure that only one sawtooth is generated, even though several trigger pulses might be produced after the phenomenon of interest. Of course, the single sawtooth in question must be triggered by a trigger pulse. To this end, the SINGLE button must be pressed. The first trigger pulse that appears after the button has been released will start the time-base generator.
The time-base generator is then blocked until the SINGLE button is pressed again. The NOT TRIG'D lamp will light up as soon as the SINGLE button has been released, until the trigger pulse arrives.

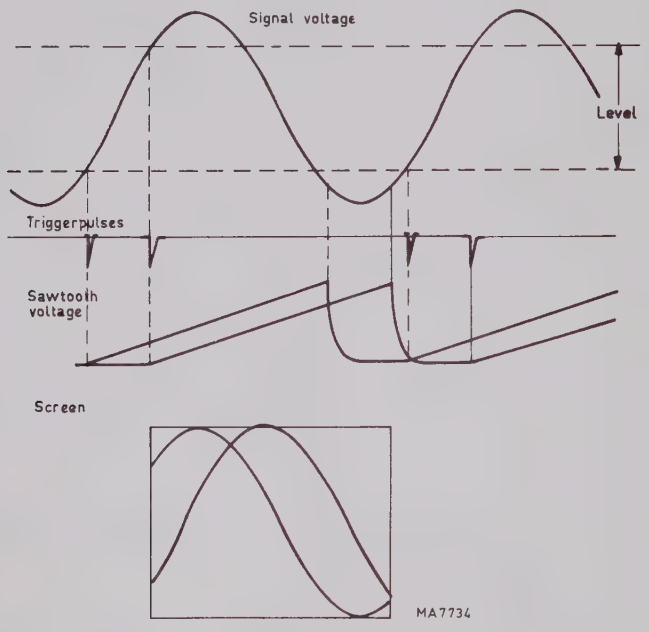

Fig. 2.4. Scanning the waveform by means of the LEVEL potentiometer

2.2.5. Time-base MAGNifier

The time-base magnifier is operated by a two-position push-pull switch incorporated in the horizontal-POSITION control. If this switch is pulled to position x10, the sweep speeds of the main time-base generator are increased by a factor of 10. Thus, the portion of the signal displayed over a width equal to one division in the centre of the screen in the x1 position (T B MAGNifier depressed), will occupy the full width of the screen in the x10 position.
Any portion of the trace can be brought on to the screen by the horizontal-POSITION control for scrutinisation. In the x10 position, the time coefficient is determined by dividing the indicated TIME/DIV value by 10.

2.2.6. Use of the delayed time-base

The delayed time-base can be used for the accurate study of complex signals. When push-button STARTS of the STARTS/TRIG controls is operated, immediately the delayed-time base is on (i.e. the TIME/DIV switch is not at OFF), a portion of the displayed signal is intensified in the MAIN TB position of the horizontal deflection controls. The DELAY TIME control enables this intensified portion to be shifted along the time axis. The duration of the intensified portion, its length, can be controlled in steps and continuously by means of the TIME/DIV controls of the delayed time-base generator. When push-button DEL'D TB of the horizontal deflection controls is operated, the intensified portion occupies the full width of the screen. In the DEL'D TB position, the delay time, (i.e. the interval between the starting point of the main time-base and the starting point of the delayed time-base) is determined by the settings of the main TIME/DIV controls and the DELAY TIME control.

If the TRIG button of the STARTS/TRIG controls is operated, the delayed time-base is started by the first trigger pulse that occurs after the selected delay time. This trigger pulse is supplied by the trigger unit of the delayed time-base generator. This position is used when time jitter would otherwise give a blurred image of the detail under observation. This time jitter could be part of the signal being investigated or, at extreme magnifications, originate in the time-base circuits.

Bedienungsanleitung

1. Allgemeines

1.1. EINLEITUNG

Der tragbare Oszillograf PM 3260 gestattet Messungen von Signalen bei hoher Empfindlichkeit (5 mV/Teil) über eine grosse Bandbreite (120 MHz). Der Oszillograf ist mit vielen Dünnfilmschaltungen bestückt, wodurch ein stabiler Betrieb gewährleistet ist und die Zahl der Abgleichorgane verringert wird.
Es gibt eine grosse Auswahl von Darstellungsmöglichkeiten.
Es können ein oder zwei Kanäle dargestellt werden.
Die Addition beider Kanäle ist ebenfalls möglich.
Durch die Invertierungsmöglichkeit beider Kanäle können auch Differenzen gebildet werden.
Der Oszillograf ist mit einer Hauptzeitablenkung und einer verzögerten Zeitablenkung ausgerüstet.

Der PM 3260 hat eine Speisung mit niedriger Verlustleistung, die bei jeder beliebigen Wechselspannung zwischen 90 V und 264 V betriebsfähig ist, wodurch sich eine Einstellung auf die örtliche Netzspannung erübrigt.

Durch all diese Eigenschaften eignet sich der Oszillograf für einen grossen Einsatzbereich.

Oszillograf PM 3260E ist ein ähnliches Gerät, jedoch ohne kalibrierten DELAY TIME Knopf und ohne Messkopfspeisung.

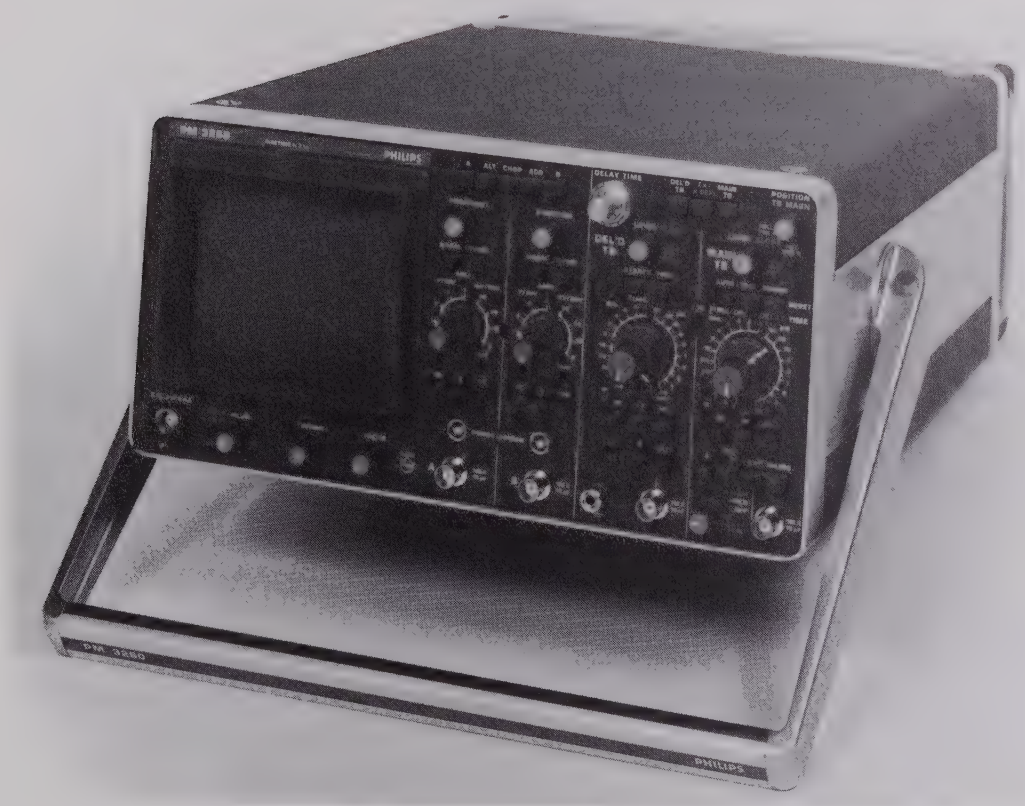

Abb. 1.1. Tragbarer Zweistrahl-Oszillograf PM 3260.

1.2. TECHNISCHE DATEN

Diese Spezifikation gilt nach 15 Minuten Anwärmzeit des Gerätes. Zahlenwerte mit Toleranzangabe werden garantiert. Zahlenwerte ohne Toleranzangabe geben die Eigenschaften eines durchschnittlichen Gerätes an und sind nur zur Orientierung.

Benennung	Beschreibung	Nähere Angaben
1.2.1. ELEKTRONENSTRAHLRÖHRE		
Typ	PHILIPS D14-240	Rechteckiger Schirm, mit Netzelektrode und Nachbeschleunigung, metallhinterlegter Leuchtschirm.
Ausnutzbare Schirmfläche	80 mm x 100 mm	
Schirmtyp	P31 (GH) Phosphor	P7 (GM) Phosphor auf Wunsch lieferbar
Photografische Schreibgeschwindigkeit	1500 cm/μs	Gemessen mit Steinheil Oscillophot M5 Kamera. Blende: 1:1,2 Bildausschnitt Verhältnis: 1:0,5 Film: Polaroid 410 (10000 ASA) Keine Vorbelichtung Phosphor Typ P31 (GH)
Gesamte Beschleunigungsspannung	20 kV	
Raster	Intern	Stufenlos einstellbare Rasterbeleuchtung
Einleitung	Zentimetereinteilung mit Untereinteilung von 2 mm an den mittleren Achsen. Gestrichelte Linien bei 10 % und 90 % des Messrasters, zur Messung von Anstiegzeiten	
1.2.2. VERTIKALE ODER Y-ACHSE		
1.2.2.1. Kennlinie		
Frequenzbereich	d.c. ... 120 MHz 10 Hz ... 120 MHz	−3 dB, Gleichspannungskopplung −3 dB, Wechselspannungskopplung
Anstiegzeit	$\approx$ 3 ns	
Überschwingen	±3 % (4 % Spitze-Spitze)	
1.2.2.2. Ablenkkoeffizienten	5 mV/Teil ... 2 V/Teil	Neun kalibrierte Stellungen, Folge 1-2-5. Nicht kalibriert stufenlos einstellbar 1 : $\geqslant$ 2,5
1.2.2.3. Fehlergrenze	±3 %	
1.2.2.4. Hochstzulässige Eingangsspannung	±400 V 800 V_{ss}, Wechselspannung	Gleichspannung + Spitzenwert einer Wechselspannung. Bis zur 20 mV Stellung des Eingangsabschwächers Minderung bei Frequenzen über 500 kHz. Siehe Abbildung 1.2.
1.2.2.5. Instabilität des Leuchtflecks		
Bildsprung	$<$ 0,3 Teil	Beim Schalten zwischen den Stellungen des Abschwächers
Bildsprung	$<$ 0,3 Teil	Beim Schalten des NORM/INVERT Schalters
Bildverschiebung	$<$ 0,3 Teil	Beim Drehen des kontinuierlichen Abschwächers
Bildverschiebung	$<$ 1 Teil	Beim Eindrücken der Taste ADD.
Temperatur Drift	60 μV/°C	Mittelwert

Benennung	Beschreibung	Nähere Angaben
1.2.2.6. Maximale Ablenkung		
Unverzerrt	24 Teile	
Verschiebungbereich	16 Teile	8 Teile über und unter mittleren Rasterlinie.
1.2.2.7. Eingangsimpedanz	1 MOhm//15 pF	
1.2.2.8. Zeitkonstante der Eingangsschaltung	⩾ 17 ms	Kopplungsschalter auf AC
1.2.2.9. Sichtbare Signalverzögerung	ca. 30 ns	
1.2.2.10. Darstellungsmöglichkeiten	nur Kanal +A oder −A nur Kanal +B oder −B Kanäle ±A und ±B zerhackt Kanäle ±A und ±B abwechselnd Kanäle ±A und ±B addiert	
1.2.2.11. Chopperfrequenz	≈ 1 MHz	
1.2.2.12. Übersprechen zwischen Kanälen	1:500	2 Teile Signalamplitude bei 50 MHz auf einem Kanal, eingestellt auf 0.2 V/Teil. Übersprechen wird gemessen am anderen Kanal, eingestellt auf 20 mV/Teil.
1.2.2.13. Gleichtaktunterdrückung	100 bei 100 kHz 100 bei 1 MHz 20 bei 50 MHz	Gemessen mit +A und −B Addiert Max. Gleichtaktsignal 8 Teile
1.2.3. HORIZONTALE ODER X ACHSE		
1.2.3.1. Darstellungsweisen	– Hauptzeitablenkung – Hauptzeitablenkung aufgehellt durch verzögerte Zeitablenkung – Verzögerte Zeitablenkung – XY-Betrieb	X Ablenkung durch: – Kanal A Signal – Kanal B Signal – Signal über EXT Anschluss der Hauptzeitablenkung – Netzfrequenz
1.2.4. HAUPTZEITABLENKUNG		
1.2.4.1. Betriebsart	Getriggert Automatisch Einmalig	Automatischer Freilauf bei Abwesenheit von Triggersignalen möglich
1.2.4.2. Zeitmassstäbe	1 s/Teil ... 50 ns/Teil	In 23 Kalibrierten Stufen, Folge 1-2-5. Dazwischen stufenlos einstellbar 1 : ⩾ 2,5 nicht kalibriert
1.2.4.3. Fehlergrenze des Zeitmassstabes	±2 % ±3 %	+20 °C ... +30 °C + 5 °C ... +40 °C Zeitablenkungs-Genauigkeit für 2 beliebige Teile von 10-Teil-Zeitablenkung ist ±5 %. Die ersten und letzten Teile der 5 ns und 10 ns gedehnten Zeitablenkung sind auszuschliessen.

Benennung	Beschreibung	Nähere Angaben
1.2.4.4. Anzeigendehnung		
Dehnung	10x	Geschaltet, kalibriert
Zusätzliche Abweichung	±1 %	Erste und letzte 50 ns von 5 ns, 10 ns und 20 ns der gedehnten Zeitablenkung sind auszuschliessen
Kürzester Zeitmassstab	5 ns/Teil	
1.2.4.5. Regelbare Sperrzeit	Die Zeitablenk-Sperrzeit kann ca. 10x erhöht werden	
1.2.5. VERZÖGERTE ZEITABLENKUNG		
1.2.5.1. Betriebsart	Verzögerte Zeitablenkung startet nach Wahl, entweder sofort nach Ablauf der Verzögerungszeit oder nach Empfang des ersten Triggerimpulses nach Verstreichen der Verzögerungszeit	
1.2.5.2. Zeitmassstäbe	0,5 s/Teil ... 50 ns/Teil	In 22 kalibrierten Stufen (Folge 1-2-5). Dazwischen stufenlos einstellbar 1 : ⩾ 2,5 nicht kalibriert.
1.2.5.3. Fehlergrenze des Zeitmassstabes	±2 % ±3 %	+20 °C ... +30 °C + 5 °C ... +40 °C Zeitablenkungs-Genauigkeit für zwei beliebige Teile von 10-Teil-Zeitablenkung ist ±5 %. Die ersten und letzten Teile der 5 ns und 10 ns gedehnten Zeitablenkung sind auszuschliessen.
1.2.5.4. Verzögerungszeit	Stufenlos zwischen 0x und 10x der Zeitkoeffizient, der Hauptzeitablenkung	Kalibriert in der Standardausführung PM 3260. Bereich des Verzögerungszeitvervielfachers 0.00-9.99. Inkrementale Genauigkeit 0,5 %, typisch 0,2 %. Nicht kalibriert in der PM 3260E Ausführung.
1.2.5.5. Verzögerungszeitjitter	< 1:20.000	Mittelwert 1:30.000
1.2.6. X ABLENKUNG		
X Ablenkung über Y_A		
1.2.6.1. Ablenkkoeffizient	5 mV/Teil ... 2 V/Teil	Nicht kalibriert stufenlos einstellbar 3:1 über potentiometer X AMPL
1.2.6.2. Koeffizientabweichung	±5 %	
1.2.6.3. Bandbreite	0 ... 2 MHz	–3 dB Bandbreite über 8 Teile
1.2.6.4. Eingangsimpedanz	1 MOhm//15 pF	
1.2.6.5. Phasenverschiebung	3° bei 100 kHz	
X Ablenkung über Y_B		
Externe X Ablenkung über Buchse EXT		
Gleich zu der X-Ablenkung über Kanal Y_A, aber mit einer Koeffizientabweichung von ± 20 %.		
1.2.6.6. Ablenkkoeffizient	300 mV/Teil	Eine kalibrierte Stellung Nicht kalibriert stufenlos einstellbar ⩾ 3:1
1.2.6.7. Bandbreite	0 ... 2 MHz	–3 dB Bandbreite über 8 Teile
1.2.6.8. Eingangscharakteristiken	Gleiche Werte wie Y Kanäle	
1.2.6.9. Phasenverschiebung	3° bei 100 kHz	

Benennung	Beschreibung	Nähere Angaben
X Ablenkung mit interner Spannung bei Netzfrequenz		
Die Ablenkung ist von der Netzspannung abhängig und ist bei Lieferung auf 8 Teile bei einer Netzspannung von 220 V eingestellt.		
1.2.7. TRIGGERUNG DER HAUPTZEITABLENKUNG		
1.2.7.1. Triggerquelle	Intern von Kanal A Intern von Kanal B Intern von Netz Extern	
1.2.7.2. Betriebsart	Automatische Triggerung	Automatischer Freilauf des Zeitablenkgenerators etwa 100 ms nach Verschwinden des Triggersignals.
	Normale Triggerung Einmaliger Ablauf der Zeitablenkung	
1.2.7.3. Triggerflanke	+ oder –	
1.2.7.4. Triggerempfindlichkeit	Intern ⩽ 0,5 Teil Extern ⩽ 150 mV	Typischer Wert als Funktion der Frequenz, siehe Abb. 1.3
1.2.7.5. Filterbandbreite	DC 0-120 MHz	Flache Wiedergabekennlinie, intern sowie extern
	LF: 0-30 kHz LF: 10 Hz-30 kHz HF: 30 kHz-120 MHz	–3 dB, Intern –3 dB, Extern –3 dB, Intern und Extern
1.2.7.6. Pegelbereich	24 Teile –3,6 V bis +3,6 V	Bei interner Triggerung Bei externer Triggerung
1.2.7.7. Eingangscharakteristiken	gleicher Wert wie Y-Kanäle	
1.2.8. TRIGGERUNG DER VERZÖGERTEN ZEITABLENKUNG		
1.2.8.1. Triggerquelle	Intern von Kanal A Intern von Kanal B Extern	
Übrige Eigenschaften sind die gleichen wie bei TRIGGERUNG DER HAUPTZEITABLENKUNG		
1.2.9. KALIBRIERUNGSEINHEIT		
1.2.9.1. Ausgangsspannung	3 V_{ss}	
1.2.9.2. Ausgangsstrom	6 mA	
1.2.9.3. Fehlergrenze	±1 %	Spannung und Strom
1.2.9.4. Frequenz	2 kHz ± 2 %	
1.2.9.5. Sicherung	Der Ausgang ist gegen Dauerkurzschlüsse gesichert	
1.2.10. STROMVERSORGUNG		
1.2.10.1. Netzspannungen	Jede Spannung zwischen 100 und 240 V ± 10 % in einem Bereich	
1.2.10.2. Netzfrequenz	46-440 Hz	
1.2.10.3. Messkopfspeisung	+ und –24 V	Bei Ausführung PM 3260E nicht eingebaut
1.2.10.4. Leistungsbedarf	45 W	

Benennung	Beschreibung	Nähere Angaben
1.2.11. UMGEBUNGSEIGENSCHAFTEN		
1.2.11.1. Umgebungstemperaturen	+5 °C ... +40 °C −10 °C ... +55 °C −40 °C ... +70 °C	Betrieb innerhalb Spezifikation Arbeitsbereich Lagerung und Transport
1.2.11.2. Höhe	5000 m 15000 m	Betriebsfähig nicht Betriebsfähig
1.2.11.3. Feuchtigkeit	Das Gerät entspricht den Anforderungen gemäss IEC 50 (CO) 142 Standard.	
1.2.11.4. Stossfestigkeit	Das Gerät entspricht den Anforderungen gemäss IEC 68 Eb Standard	
1.2.11.5. Vibration	Das Gerät entspricht den Anforderungen gemäss IEC 68 F Standard	
1.2.11.6. Akklimationszeit	15 Minuten für Normalbetrieb	Kommend von −10 °C nach +20 °C bei 60 % relativer Feuchtigkeit
1.2.12. MECHANISCHE DATEN		
1.2.12.1. Abmessung	Länge 410 mm Breite 316 mm Höhe 154 mm	Ohne Bedienungsorgane, Deckel und Füsse
1.2.12.2. Gewicht	9,3 Kg	

1.2.13. ZUBEHÖR

1.2.13.1. Standardzubehör

2 Kontrastfilterscheiben
Abdeckhaube mit Aufbewahrungsraum
Faltbarer Lichtschutztubus PM 9366
BNC Übergangsstecker PM 9051
CAL Anschlussklemme - BNC Adapter
Anleitung

1.2.13.2. Wahlzubehör

PM 9335	Passiver 1:1 Messkopf
PM 9351	Passiver 10:1 Messkopf
PM 9358	Passiver 100:1 Hochspannungsmesskopf
PM 9347*)	Aktiver T.V. Messkopf
PM 9352*)	Aktiver Miniatur Messkopf
PM 9353*)	Aktiver FET-Messkopf
PM 8960	Anpassung für Gestelleinbau
PM 8971	Kamera Flansch
PM 9380	Oszillografenkamera Serie Oszillografenkameras Steinheil Oszillophot

*) Falls diese Messköpfe mit PM 3260E benutzt werden sollen muss zusätzlich die Stromversorgung PM 9346 eingesetzt werden.

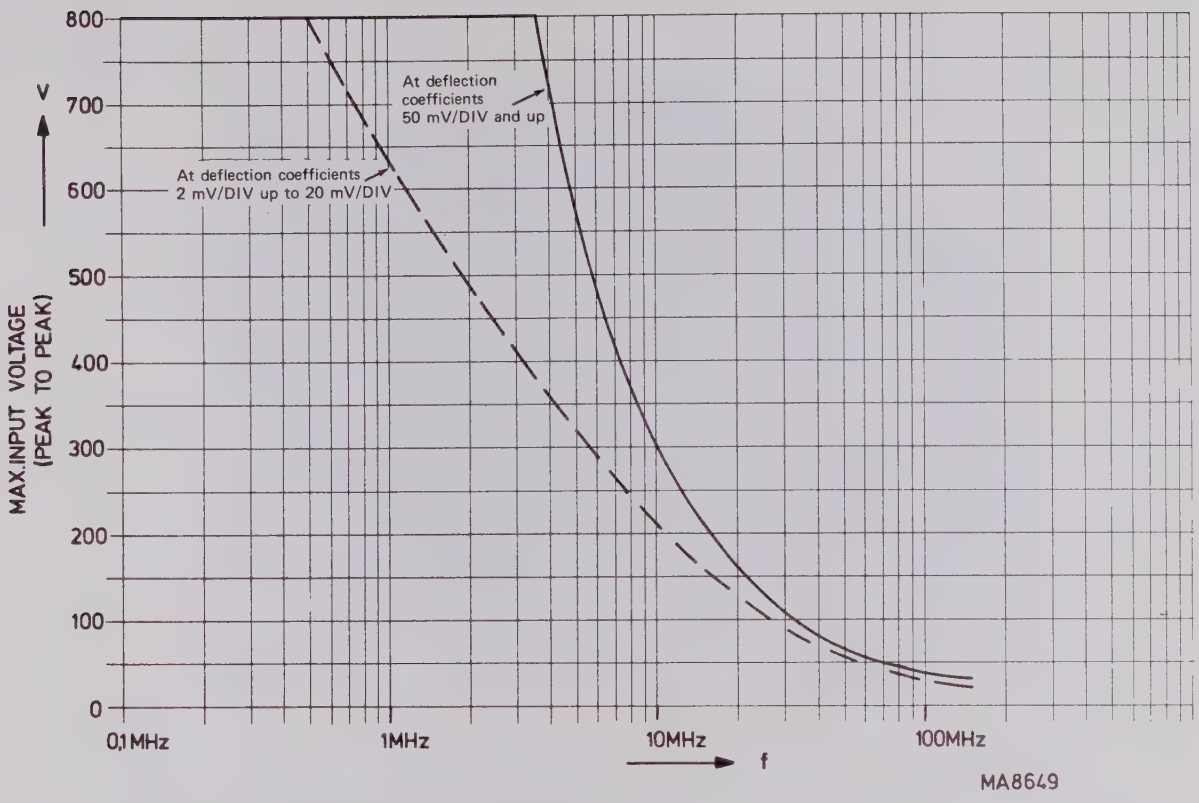

Abb. 1.2. Minderung der höchstzulässigen Eingangsspannung

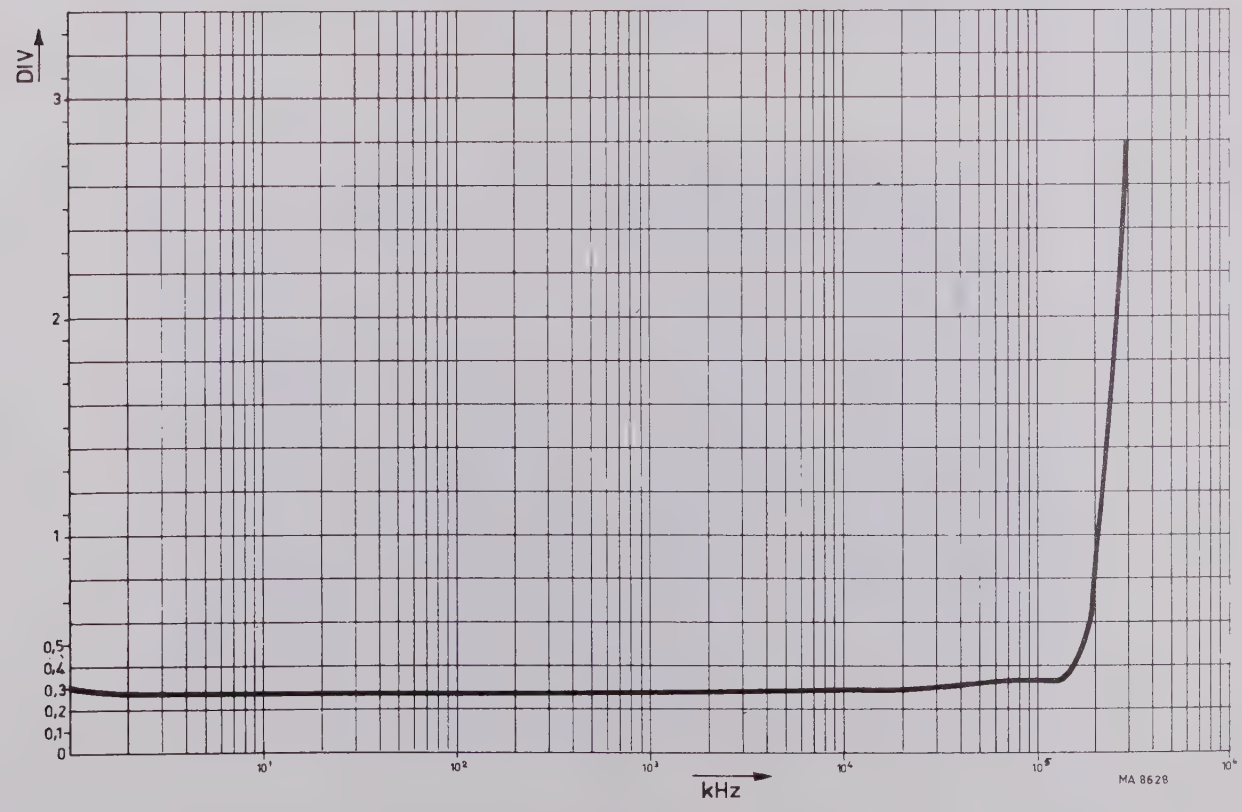

Abb. 1.3. Typische Ablenkempfindlichkeit für interne Triggerung über Kanal A

Abb. 2.1. Abnehmen der Abdeckhaube

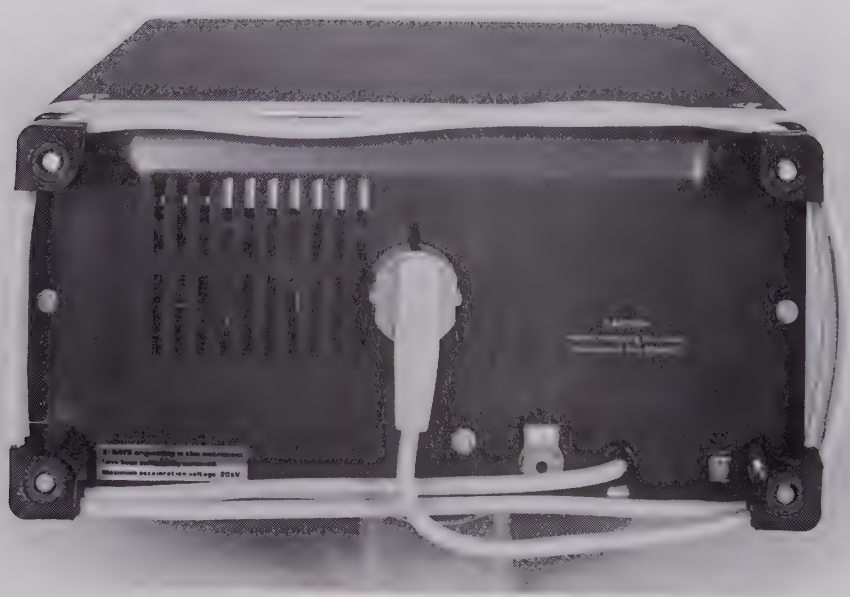

Abb. 2.2. Rückansicht des Gerätes

2. Gebrauchsanweisung

2.1. INBETRIEBNAHME

2.1.1. Abnehmen und Aufsetzen der Abdeckhaube

Abnehmen: – Den Knopf in der Mitte des Deckels eine viertal Umdrehung nach links drehen (Stellung UNLOCKED)
– Deckel abnehmen.

Aufsetzen: – Den Verriegelungsknopf in Stellung UNLOCKED drehen.
– Deckel an der Vorderseite des Oszillografen befestigen.
– Knopf eindrücken und eine viertel Umdrehung nach rechts drehen (Stellung LOCKED).

Bemerkung: Der Handgriff lässt sich drehen wenn die Druckknöpfe auf ihren Lagern eingedrückt werden.

Warnung: In diesem Gerät werden hohe Spannungen erzeugt, deshalb darf es niemals in geöffnetem Zustand eingeschaltet werden.
Vor Wartungsarbeiten ist der Netzstecker zu ziehen und ist darauf zu achten dass alle Hochspannung führenden Teile entladen sind.

2.1.2. Netzspannungseinstellungen und Sicherung

Da das Gerät bei jeder Netzspannung zwischen 90 und 264 V betriebsfähig ist, erübrigt sich das Umschalten auf die örtliche Netzspannung.
Der Sicherungshalter an der Rückwand enthält eine Sicherung von 2 A, träge. Die Verwendung reparierter Sicherungen und das Kurzschliessen des Sicherunghalters sind verboten.

2.1.3. Erdung

Aus Sicherheitsgründen muss der Oszillograf entweder über den Erdanschluss an der Rückseite (gekennzeichnet ⏚), oder über das Netzkabel, vorausgesetzt das Gerät wird an eine Schukosteckdose angeschlossen, geerdet werden.
Es ist zu beachten dass die Erdverbindung des Oszillografen nicht durch ein Verlängerungskabel oder irgendeine andere Vorrichtung unterbrochen wird, die keinen Erdleiter besitzt.

2.1.4. Einschalten

Der Schalter POWER ist gekoppelt mit der Rasterbeleuchtungseinsteller ILLUM und befindet sich an der Vorderseite des Gerätes unter dem Bildröhrenrahmen.
Der Oszillograf darf niemals eingeschaltet werden, wenn eine Leiterplatte oder Baustein entfernt wurde.
Eine Leiterplatte oder Baustein darf nicht früher als eine Minute nach Ausschaltung des Gerätes entfernt werden.

2.2. BEDIENUNGSANLEITUNG

Vor dem Einschalten ist zu kontrollieren, ob der Oszillograf gemäss Abschnitt 2.1. "INBETRIEBNAHME" angeschlossen ist, und ob die dort erwähnten Vorsorgemassnahmen beachtet wurden.

2.2.1. **Bedienungsorgane und Buchsen** (Abb. 2.3.)

2.2.1.1. Vertikalkanäle

A/ALT/CHOP/ADD/B	Einstellung der Darstellungsarten, Drucktastenschalter mit 5 Stellungen.
A eingedrückt	Vertikalablenkung durch Signal von Kanal A.
ALT eingedrückt	Das Bild wird am Ende (jeder Periode) des Zeitablenksignales von einem Vertikalkanal auf den anderen umgeschaltet.
CHOP eingedrückt	Das Bild wird mit einer Festfrequenz von einem Kanal auf den anderen umgeschaltet.
ADD eingedrückt	Vertikalablenkung durch die Summe der Signale von Kanal A und B.
B eingedrückt	Vertikalablenkung durch Signal von Kanal B. Wird keine Taste eingedrückt ist die Betriebsweise des Gerätes wie bei Einstellung ALT.
POSITION	Stufenlose Einstellung der vertikalen Lage des Bildes.
NORM/INVERT	Drucktastenschalter mit zwei Stellungen zur Umkehrung der Signalpolarität. Ist keine Taste eingedrückt so gilt Einstellung NORM.
AMPL	Stufenweise Einstellung der Vertikalablenkkoeffizienten. Wahlschalter mit 9 Stellungen.
AMPL/CAL	Stufenlose Einstellung der Vertikalablenkkoeffizienten. In Stellung CAL ist der Ablenkkoeffizient kalibriert.
BAL (Schraubenziehereinstellung)	Stufenlose Einstellung des Gleichspannungsgleichgewichtes des Vertikalverstärkers.
GAIN (Schraubenziehereinstellung)	Stufenlose Einstellung der Gesamtverstärkung der Vertikalkanäle.
AC/0/DC	Signalkopplung, Drucktastenschalter mit 3 Stellungen.
AC eingedrückt	Kopplung über einen Sperrkondensator.
0 eingedrückt	Verbindung zwischen Eingangsschaltung und Eingangsbuchse wird unterbrochen und der Verstärkereingang geerdet.
DC eingedrückt	Direkte Kopplung Ist keine Taste eingedrückt so gilt Einstellung AC.
A 1 MOhm - 15 pF	BNC Eingangsbuchse für Kanal A
B 1 MOhm - 15 pF	BNC Eingangsbuchse für Kanal B

2.2.1.2. Horizontaler Kanal

DEL'D TB - EXT. X DEFL. - MAIN TB	Einstellung der Horizontalablenkung, Drucktastenschalter mit 3 Stellungen.
DEL'D TB eingedrückt	Die Horizontalablenkspannung wird vom verzögerten Zeitablenkgenerator geliefert.
EXT. X DEFL eingedrückt	Horizontalablenkung durch das Signal von Kanal A, das Signal von Kanal B oder durch ein Netzfrequenzsignal.
MAIN TB eingedrückt	Horizontalablenkspannung wird vom Hauptzeitablenkgenerator geliefert; ein Teil der Darstellung wird aufgehellt (Ausgenommen in Stellung OFF des TIME/DIV Schalters des verzögerten Zeitablenkgenerators). Ist keine Taste eingedrückt so gilt Einstellung MAIN TB.

POSITION TB MAGN — Stufenlose Einstellung der horizontalen Lage des Bildes; gekoppelt mit einem Zug-Druck-Schalter der den Horizontalablenkkoeffizienten 10 mal steigert.
Eine Signallampe leuchtet auf wenn die Dehnung x10 eingeschaltet ist.

X AMPL/HOLD OFF — Stufenlose Einstellung des Horizontalablenkkoeffizienten bei externer X-Ablenkung.
Bei X-Ablenkung durch die Hauptzeitablenkung kann diese Einstellung zur Steigerung der Sperrzeit benutzt werden.

2.2.1.3. Hauptzeitablenkgenerator

LEVEL — Stufenlose Einstellung des Triggersignalpegels bei welchem der Zeitablenkgenerator startet. Diese Einstellung ist gekoppelt mit einem Zug-Druck-Schalter zur Triggerungswahl auf der positiv oder negativ gerichteten Flanke des Triggersignales.

NOT TRIG'D — Signallampe leuchtet auf bei Wartestellung des Zeitablenkgenerators.

AUTO - TRIG - SINGLE — Triggerart-Einstellungen; Drucktastenschalter mit 3 Stellungen.

AUTO eingedrückt — Liegt kein Triggersignal an so läuft der Hauptzeitablenker frei.

TRIG eingedrückt — Der Zeitablenkgenerator wird auf normale Weise getriggert.

SINGLE eingedrückt — Nach Betätigung der Taste SINGLE, läuft der Zeitablenkgenerator nach Empfang eines Triggersignals nur einmal ab.

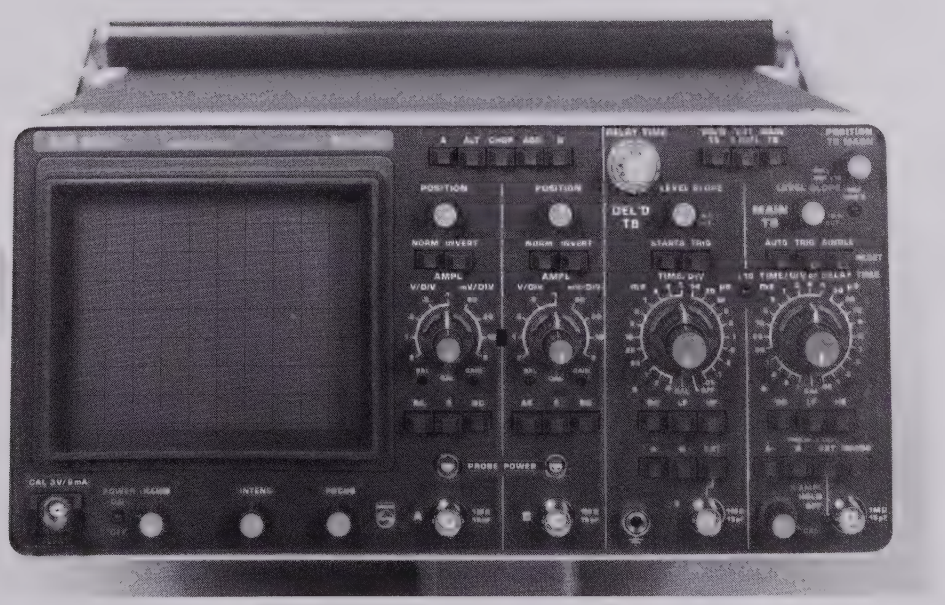

Abb. 2.3. Vorderansicht des Gerätes

TIME/DIV or DELAY TIME	Einstellung des Zeitkoeffizienten der Hauptzeitablenkung; Drehschalter mit 23 Stellungen.
TIME/DIV-CAL (blau)	Stufenlose Einstellung des Zeitkoeffizienten der Hauptzeitablenkung. In Stellung CAL ist der Zeitkoeffizient kalibriert.
DC-LF-HF	Triggerkopplung; Drucktastenschalter mit 3 Stellungen.
DC	Triggersignale direkt gekoppelt.
LF	Kopplung über Tiefpass für Frequenzen bis 30 kHz (für externe Triggerung über einen Bandfilter von 10 Hz bis 30 kHz).
HF	Kopplung über Hochpass für Frequenzen über 30 kHz. Ist keine Taste eingedrückt so gilt Einstellung DC.
TRIG oder X DEFL	Wähler für Triggerquelle oder externe X Ablenkung. Drucktastenschalter mit 4 Stellungen.
A	Internes Trigger- oder X-Ablenksignal von Kanal A.
B	Internes Trigger- oder X-Ablenksignal von Kanal B.
EXT	Triggerung auf externes Signal über angrenzende 1 MOhm - 15 pF Buchse. Durch eindrücken der Taste EXT X-DEFL der Horizontalablenkungs-Einstellung wird diese Buchse mit dem Eingang des Horizontalverstärkers verbunden.
MAINS	Triggerung- oder X-Ablenkungssignal von einer internen Spannung mit der Netzfrequenz. Ist keine Taste eingedrückt so gilt Einstellung A.
1 MOhm - 15 pF	BNC Buchse für externe Triggerung oder Horizontalablenkung.

2.2.1.4. Verzögerter Zeitablenkgenerator

DELAY TIME	Stufenlose Einstellung der Verzögerungszeit, wirkt zusammen mit der TIME/DIV Einstellung des Hauptzeitablenkgenerators.
LEVEL SLOPE	Stufenlose Einstellung zur Pegelwahl des Triggerungsignals, bei welchem der verzögerte Zeitablenkgenerator startet. Diese Einstellung ist gekoppelt an einen Zug-Druck-Schalter zur Triggerungswahl auf der positiv oder negativ gerichteten Flanke des Triggersignals.
STARTS - TRIG	Wahl des Anfangspunktes des verzögerten Zeitablenkgenerators nach Ablauf der eingestellten Verzögerungszeit. Drucktastenschalter für 2 Einstellungen.
STARTS	Der verzögerte Zeitablenkgenerator wird sofort nach Ablauf der Verzögerungszeit gestartet.
TRIGG	Der verzögerte Zeitablenkgenerator wird nach Ablauf der Verzögerungszeit nach Erhalt eines Triggerimpulses gestartet. Ist keine Drucktaste eingedrückt so gilt Einstellung STARTS.
TIME/DIV	Einstellung des Zeitkoeffizienten der verzögerten Zeitablenkung. Drehschalter mit 23 Stellungen. In Stellung OFF wird die verzögerte Zeitablenkung abgeschaltet.
TIME/DIV - CAL (blau)	Stufenlose Einstellung des Zeitkoeffizienten der verzögerten Zeitablenkung. In Stellung CAL ist der Zeitkoeffizient kalibriert.
DC - LF - HF	Triggerkopplung; Drucktastenschalter mit 3 Stellungen.
DC	Triggersignale direkt gekoppelt.
LF	Kopplung über Tiefpass für Frequenzen bis 30 kHz (für externe Triggerung über einen Bandfilter von 10 Hz bis 30 kHz).
HF	Kopplung über Hochpass für Frequenzen über 30 kHz. Ist keine Taste eingedrückt so gilt Einstellung DC.

A - B - EXT	Triggerquellen Einstellung; Drucktastenschalter mit 3 Stellungen.
A	Internes Triggerungssignal von Kanal A.
B	Internes Triggerungssignal von Kanal B.
EXT	Triggerung auf ein externes Signal über angrenzende 1 MOhm - 15 pF Buchse. Ist keine Taste eingedrückt so gilt Einstellung A.
1 MOhm - 15 pF	BNC Eingangsbuchse für externes Triggersignal.

2.2.1.5. Elektronenstrahlröhre

ILLUM POWER	Stufenlose Einstellung der Rasterbeleuchtung; zugleich Netzschalter. Signallampe zeigt Betriebszustand (ON) an.
INTENS	Stufenlose Einstellung der Helligkeit des Bildes.
FOCUS	Stufenlose Einstellung zur Fokussierung des Elektronenstrahls.

2.2.1.6. Verschiedenes

CAL	Ausgangsbuchse an der eine Rechteckspannung von 3 V_{SS} und ein Strom von 6 mA mit einer Frequenz von 2 kHz zur Verfügung steht. Amplituden-Genauigkeit: ±1 %. Frequenz-Genauigkeit: ±2 %. Der Ausgang ist gegen Dauerkurzschlüsse gesichert.
PROBE POWER	Speisungsbuchse für aktives Zubehör; liefert +24 V und −24 V.
⏚	Messerde

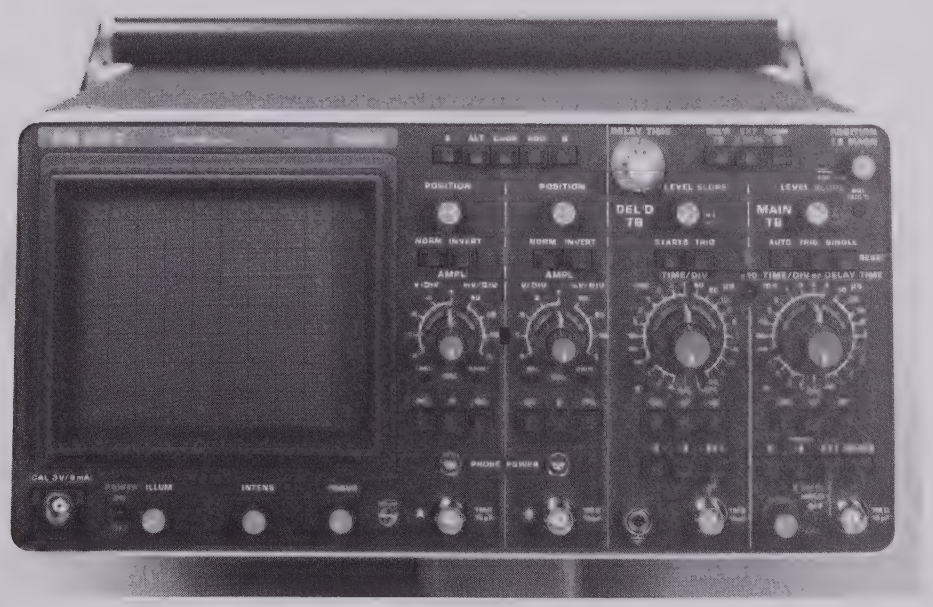

Abb. 2.3. Vorderansicht des Gerätes

2.2.2. Vorbereitende Einstellungen

Da die folgenden Einstellungen für beide vertikale Kanäle gleich sind, ist nur die Vorschrift für Kanal A gegeben.

2.2.2.1. Einstellen Gleichspannungsgleichgewicht

- Drucktaste A des Darstellungsartenschalters betätigen.
- Drucktaste AUTO des Triggerartenschalters betätigen.
- Drucktaste MAIN TB des Horizontalablenkungsschalters betätigen.
- Schalter AMPL in Stellung 5 mV und stufenlosen Einsteller in Stellung CAL bringen.
- Bild mit Einsteller POSITION zentrieren.
- Mit Einstellern INTENS und FOCUS die Schärfe des Bildes regeln.
  Nicht erwähnte Einstellungen dürfen in jeder beliebigen Stellung stehen.
- Es ist darauf zu achten dass das Bild nicht springt, wenn der Schalter zwischen der 5- und 10 mV-Stellung betätigt wird.
  Nötigenfalls Einstellung BAL an der Vorderseite unter dem Schalter AMPL erneut einstellen.

2.2.2.2. Verstärkungseinstellung

Falls nicht anders angegeben sind die Bedienungsorgane in den selben Stellungen wie in vorgehender Einstellvorschrift.

- Schalter AC-0-DC in Stellung DC.
- Schalter AMPL in Stellung 0,5 V und stufenlosen Einsteller in Stellung CAL.
- Buchse CAL mit Eingangsbuchse A verbinden.
- Prüfen ob die Bildhöhe 6 Teile beträgt.
  Nötigenfalls Einstellung GAIN unter dem Schalter AMP neu einstellen.

2.2.3. Eingänge A und B und ihre Möglichkeiten

Der Oszillograf besitzt zwei identische Kanäle, die entweder zusammen mit einem oder beiden Zeitablenkgeneratoren für YT Messungen, oder aber zusammen mit dem externen Horizontalkanal für XY Messungen verwendet werden können.

2.2.3.1. YT-Messungen

Zur Darstellung eines Signals ist einer der beiden Vertikalkanäle mit Taste A oder Taste B der Darstellungsartenschalter zu wählen.
Wird Taste ALT oder CHOP gedrückt, können zwei verschiedene Signale gleichzeitig abgebildet werden. Der Y-Ablenkkoeffizient und die Polarität können für jeden Kanal getrennt gewählt werden. Wird Taste ALT betätigt wird die Darstellung beim Rücklauf des Zeitablenksignals von einem Kanal auf den anderen umgeschaltet. Obwohl Stellung ALT für alle Ablenkzeiten verwendet werden kann, ergibt für lange Ablenkzeiten Stellung CHOPPED eine bessere Bildgüte, da das abwechselnde Darstellen der beiden Eingangssignale während dieser langen Ablenkzeiten deutlicher sichtbar ist.

In Stellung CHOPPED, wird die Darstellung mit einer Festfrequenz von einem Kanal auf den anderen umgeschaltet.
In Stellung ADDED des Darstellungsartenschalters werden die Signalspannungen der beiden vertikalen Kanäle addiert. Abhängig von der Stellung der Polaritätsschalter wird entweder die Summe oder die Differenz der Eingangssignale dargestellt. Die Einstellung ADDED ermöglicht auch Differenzmessungen. Bei diesen Messungen wird die Gleichtaktunterdrückung der Stellung ADDED ausgenützt. Wenn die Polaritätsschalter beider Kanäle in entgegengesetzten Stellungen stehen, werden die Gleichtaktteile der Signale von Kanal A und B im Verhältnis zu den Gegentaktteilen nur sehr geringfügig verstärkt.

2.2.3.2. XY-Messungen

Wenn Drucktaste EXT X DEFL des Horizontalablenkungsschalters und Taste A des TRIG OR X DEFL-Schalters eingedrückt sind ist der Zeitablenkgenerator ausgeschaltet. Ein Signal das über Kanal A zugeführt wird kann nur zur Horizontalablenkung verwendet werden. Der Schalter AC/0/DC und der Stufenabschwächer von Kanal A bleiben wirksam.
Einsteller X DEFL/HOLD OFF ermöglicht stufenlose Einstellung der Ablenkungskoeffizienten, für horizontale Verschiebung des Bildes wird Einsteller X POSITION verwendet.

Für X Ablenkung kann auch der vertikale Kanal B verwendet werden.
In diesem Fall Taste B des TRIG OR X DEFL-Schalters eindrücken.

Es ist ferner möglich eine interne Spannung der Netzfrequenz, oder ein Signal angelegt an die EXT Buchse (Vorderseite rechts unten), für die X-Ablenkung zu verwenden. Zu diesem Zweck die betreffende Drucktaste des TRIG OR X DEFL-Schalters eindrücken.
Bei diesen Betriebsarten kann die Bildbreite mit dem X DEFL/HOLD OFF Potentiometer eingestellt werden. Mit diesem Potentiometer in Stellung CAL, beträgt der Ablenkungskoeffizient für externe Signale 300 mV/Teil.

2.2.3.2. AC/0/DC Schalter

Die zu beobachtenden Signale sind an die Buchse (n) A und/oder B zu legen und der AC/0/DC Schalter abhängig von der Zusammensetzung der Signale auf AC oder DC zu stellen. Da der vertikale Verstärker gleichspannungsgekoppelt ist, ist die ganze Bandbreite des Gerätes verfügbar und die Gleichspannungskomponenten werden in Stellung DC des AC/0/DC-Schalters als Bildverschiebungen sichtbar.
Sind kleine Signale hohen Gleichspannungen überlagert kann dies störend sein. Jede Abschwächung des Signals verursacht auch eine Abschwächung der kleinen Wechselspannungskomponenten. In diesem Falle ist der Eingangsschalter in AC Stellung zu bringen wodurch ein Sperrkondensator die Gleichspannungs- und Niederfrequenz-Signale unterdrückt. Dies hat Dachschräge zur Folge bei Darstellungen von Niederfrequenzsignalen.
Stellung 0 unterbricht das Signal und erdet den Verstärkereingang um den 0 V Pegel schnell bestimmen zu können.

2.2.4. Triggerung

Wenn ein Signal dargestellt werden soll, muss, um ein stillstehendes Bild zu erhalten, die Horizontalablenkung stets an einem festen Punkt des Signals gestartet werden.
Der Zeitablenkgenerator wird folglich von in der Triggereinheit erzeugten schmalen Triggerimpulsen gestartet und durch ein Signal gesteuert das entweder den vertikalen Eingangssignalen, einer internen Netzfrequenzspannung oder einer externen Quelle entstammen kann.

2.2.4.1. Triggerkopplung

Mit Schalter DC/LF/HF kann man drei verschiedene Triggerkopplungsarten wählen. In den Stellungen HF und LF ist die Übertragungscharakteristik begrenzt.
In Stellung DC wird das Triggersignal unverändert durchgelassen.
In Stellung LF wird ein 0 Hz (10 Hz bei externer Triggerung) bis 30 kHz Bandpass eingesetzt. Diese Stellung dient zur Verminderung von Störungen durch Rauschen.
In Stellung HF wird ein 30 kHz Hochpass eingesetzt. Diese Stellung kann zum Herabsetzen von Störungen durch Brummen verwendet werden.

2.2.4.2. Selektieren der Triggerquelle und Einstellen des Triggerpegels

Das Triggersignal kann von Kanal A (Taste A gedrückt), von Kanal B (Taste B gedrückt), von einer externen Quelle (Taste EXT gedrückt) oder einer internen Spannung mit Netzspannung (Taste MAINS gedrückt) entnommen werden.
Der Triggerimpulsformer ist ein zweifach gesteuerter Multivibrator, der von den Ausgangssignalen eines Differenzverstärkers gesteuert wird.
Das Triggersignal, das nicht vom stufenlosen Einsteller AMPL beeinflusst wird, wird zusammen mit Gleichspannungen die mittels Potentiometer LEVEL einstellbar sind, den Eingängen des Differenzverstärkers zugeführt.
Abhängig von der LEVEL Einstellung wird ein bestimmter Teil des Triggersignals durch den Differenzverstärker verstärkt.
Der Multivibrator ist somit auf einen fasten Punkt des Triggersignals geschaltet (Abb. 2.4.). Das bedeutet, dass es mit Hilfe des Einstellers LEVEL möglich ist die Form des Triggersignals abzutasten (bei interner Triggerung A oder B gleich der Form des darzustellenden Signals) und somit den Punkt zu wählen, an dem der Multivibrator umgeschaltet wird.
Der Potentiometer ist mit einem Zug-Druck-Schalter versehen, der die Wahl der Triggerflanke erlaubt.

2.2.4.3. Automatische Triggerung

Wenn Taste AUT des AUTO-TRIG-SINGLE-Schalters gedrückt ist - und wenn keine Triggerimpulse vorhanden sind - ist der Zeitablenkgenerator automatisch freilaufend. Das Bild ist daher stets sichtbar. Die Stellung AUTO kann in allen Fällen verwendet werden in welchen auch Stellung TRIG anwendbar ist, ausgenommen bei Signalfrequenzen niedriger als 10 Hz oder Impulsreihen mit einer "AUS"-Zeit über 100 ms.
Sobald Triggerimpulse vorhanden sind, wird der Freilauf des Zeitablenkgenerators automatisch beendet und der Zeitablenkgenerator erneut getriggert wie erwähnt in Abschnitt 2.2.4.1. und 2.2.4.2.
Wird Taste TRIG oder Taste SINGLE eingedrückt ist die Automatik ausgeschaltet.

2.2.4.4. SINGLE-SWEEP-Triggerung

Wenn einmalige Vorgänge beobachtet (und in der Regel fotografiert) werden müssen, ist es oft wünschenswert dafür zu sorgen, dass nur ein Sägezahn erzeugt wird, selbst wenn möglicherweise nach Darstellung dieses Vorgangs mehrere Triggerimpulse erzeugt würden. Zu diesem Zweck Taste SINGLE eindrücken. Der erste Triggerimpuls, der nach Loslassen der gedrückten Taste erscheint, startet den Zeitablenkgenerator.
Der Zeitablenkgenerator wird dann blockiert bis Taste SINGLE wieder betätigt wird. Die Lampe NOT TRIG'D leuchtet auf sobald Taste SINGLE losgelassen wird und erlischt erst wenn der Sägezahn beendet ist.

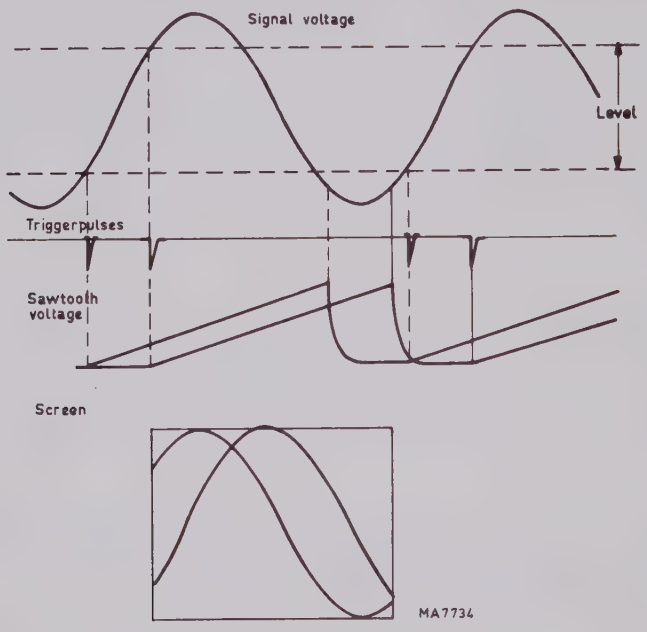

Abb. 2.4. Abtasten der Wellenform mittels des LEVEL Potentiometers

2.2.5. Dehnung der Zeitablenkung

Die Dehnung der Zeitablenkung wird mit einem Zug-Druck-Schalter TB MAGN der an den Einsteller für horizontale POSITION gekoppelt ist, eingestellt. Wenn dieser Schalter in Stellung x10 gezogen ist wird ein 10 mal schnellerer Zeitmassstab des Hauptzeitablenkgenerators eingestellt. Folglich wird der Signalteil, welcher in der x1 Stellung (TB MAGN eingedrückt) über eine Breite von ein Teil (DIV) in der Schirmmitte dargestellt wird, in der x10 Stellung über die Gesamtbreite des Schirmes geschrieben.
Jeder Teil des Bildes kann mit dem horizontalen POSITION Einsteller zur genauen Beobachtung sichtbar gemacht werden.
In der x10 Stellung wird der Zeitkoeffizient durch Teilen des gegebenen Wertes TIME/DIV. durch 10 ermittelt.

2.2.6. Gebrauch der verzögerten Zeitablenkung

Die verzögerte Zeitablenkung kann zur genauen Beobachtung komplexer Signale verwendet werden. Wenn die Drucktaste STARTS des STARTS/TRIG-Schalters nach Einschalten des verzögerten Zeitablenkung (dass heisst TIME/DIV Schalter nicht in Stellung OFF) eingedrückt wird, wird sofort ein Teil des dargestellten Signals in Stellung MAIN TB des Horizontalablenkungs-Schalters zusätzlich aufgehellt. Mit dem DELAY TIME Einsteller ist dieser zusätzlich aufgehellte Teile über die Zeitachse verschiebbar. Die Zeitdauer dieses zusätzlich aufgehellten Teils ist mit den Einstellern TIME/DIV des verzögerten Zeitablenkgenerators sowohl stufenweise wie stufenlos einstellbar. Mit Drucktaste DEL'D TB des Horizontalablenkungs-Schalters wird der zusätzlich aufgehellte Teil über die gesamte Schirmbreite sichtbar gemacht. In Stellung DEL'D TB, wird die Verzögerungszeit (dass heisst die Zeit zwischen dem Startpunkt der Hauptzeitablenkung und dem Startpunkt der verzögerten Zeitablenkung) bestimmt durch die Einstellungen des Schalters TIME/DIV der Hauptzeitablenkung und die des DELAY TIME Einstellers.

In Stellung TRIG des STARTS/TRIG Schalters startet der erste Triggerimpuls nach der gewählten Verzögerungszeit die verzögerte Zeitablenkung. Die Triggereinheit des verzögerten Zeitablenkgenerators liefert diesen Triggerimpuls. Diese Stellung kommt zur Anwendung wenn durch Jitter eine undeutliche Darstellung zu beobachten ist. Dieses Jitter kann durch das beobachtende Signal selbst oder durch externe Dehnung in den Zeitablenkschaltungen entstehen.

Notice d'emploi

1. Généralités

1.1. INTRODUCTION

L'oscilloscope portatif PM 3260 permet de mesurer des signaux de faible amplitude (5 mV/DIV) sur une gamme de fréquence étendue (120 MHz). L'oscilloscope est équipé de nombreux circuits à couche mince qui garantissent un fonctionnement très stable et réduisent le nombre de points de réglage.

Il y a un large choix d'affichages possibles, tels que: l'une ou l'autre voie, deux voies alternées ou commutées, deux voies additionnées, en positions normales et inversées pour les deux signaux d'entrée, avec base de temps principale et retardée.
L'oscilloscope PM 3260 se caractérise par une alimentation à faible dissipation. Cette unité d'alimentation fonctionne pour une tension alternative comprise entre 90 V et 264 V, de sorte qu'il n'est pas nécessaire d'adapter l'appareil à la tension secteur locale.
Toutes ces caractéristiques donnent au présent oscilloscope une grande variété d'applications.

L'oscilloscope PM 3260E est un appareil identique, mais sans multiplicateur du temps de retard étalonné ni alimentation de sonde.

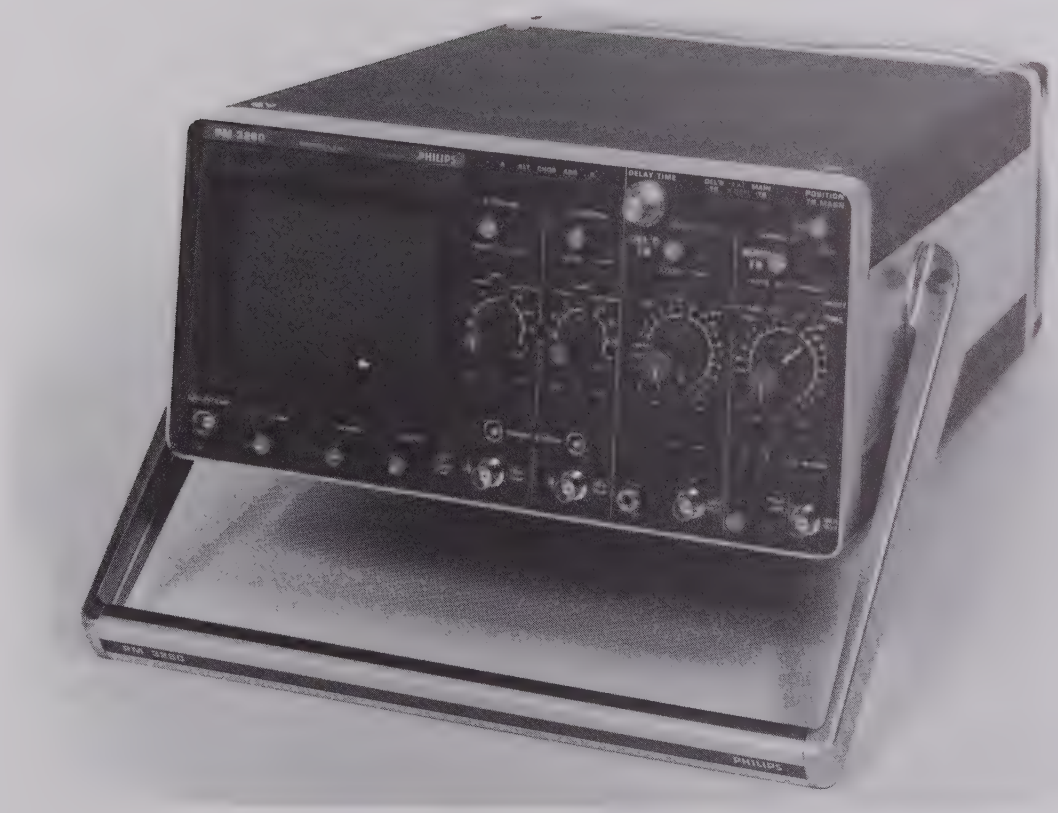

Fig. 1.1. Oscilloscope double trace portatif PM 3260

1.2. CARACTERISTIQUES TECHNIQUES

Les spécifications sont valables après que l'appareil a été préchauffé pendant 15 minutes.
Les valeurs indiquées avec tolérance sont garanties. Les chiffres sans tolérance ne servent qu'à titre d'information et correspondent aux charactéristiques d'un appareil moyen.

Désignation	Spécification	Information supplémentaire
1.2.1. TUBE A RAYONS CATHODIQUES		
Type	PHILIPS D14-240	Tube à face rectangulaire, type domed mesh, post-accélérateur, couche phosphore doublée de métal
Aire de mesure	80 mm x 100 mm	
Type d'écran	Phosphore P31 (GH)	en option, couche phosphore P7 (GM)
Vitesse d'écriture photographique	$>$ 1500 cm/μs	Mesuré avec un appareil photographique Steinheil Oscillophot M5 Ouverture: 1:1,2 Rapport objet/image: 1:0,5 Film: Polaroid 410 (10000 ASA) Pas de pré-voilage Phosphore du type P31 (GH)
Tension d'accélération totale	20 kV	
Graticule	Interne	Illumination continuellement variable
Gravures	Divisions centimétriques avec subdivisions de 2 mm sur les axes centraux. Les lignes interrompues indiquent les points 10 % et 90 % pour la mesure du temps de montée.	
1.2.2. AXE VERTICAL OU Y		
1.2.2.1. Bande passante		
Gamme de fréquence	continu à 120 MHz (–3 dB) 10 Hz ... 120 MHz (–3 dB)	largeur de bande en couplage continu largeur de bande en couplage alternatif
Temps de montée	$\approx$ 3 ns	
Dépassement	±3 % (4 % crête-à-crête)	
1.2.2.2. Coefficients de déviation	5 mV/DIV ... 2 V/DIV	en 9 positions étalonnées (progression 1-2-5) avec commande continue non-calibrée 1 : $\geqslant$ 2,5 par potentiomètre
1.2.2.3. Erreur limite	±3 %	
1.2.2.4. Tension d'entrée maximale admise	±400 V 800 V_{cc} en alternatif	tension continue + tension alternative crête. Jusqu'à la position 20 mV de l'atténuateur d'entrée réduction de la tension d'entrée maximale admise à fréquences $>$ 500 kHz Voir Fig. 1.2
1.2.2.5. Instabilité de la position du spot		
Saut de trace	$<$ 0,3 Div	Lorsque l'on commute l'atténuateur entre deux positions
Saut de trace	$<$ 0,3 Div	Lorsqu'on commute NORM/INVERT
Dérive de trace	$<$ 0,3 Div	Lorsqu'on tourne l'atténuateur continu
Dérive de trace	$<$ 1 Div	En poussant le bouton ADD
Dérive en température	$<$ 60 μV/°C	Valeur typique

Désignation	Spécification	Information supplémentaire
1.2.2.6. Déviation maximale		
Sans distorsion	24 divisions	
Gamme de décadrage	16 divisions	8 divisions vers le haut et vers la bas à partir de la ligne centrale horizontale du graticule
1.2.2.7. Impédance d'entrée	1 MOhm//15 pF	
1.2.2.8. Constant de temps RC d'entrée	⩾ 17 ms	Commutateur de couplage en position AC
1.2.2.9. Retard visible du signal	environ 30 ns	
1.2.2.10. Modes d'affichage	Voie + ou −A seulement Voie + ou −B seulement Voies ±A et ±B découpées Voies ±A et ±B alternées Voies ±A et ±B additionnées	
1.2.2.11. Fréquence de commutation	≈ 1 MHz	
1.2.2.12. Diaphonie entre voies	1 : 500	avec un signal de 2 divisions d'amplitude à 50 MHz sur une voie réglée sur 0,2 V/DIV. La diaphonie est mesurée sur l'autre voie réglée sur 20 mV/DIV
1.2.2.13. Facteur de réjection en mode commun	100 à 100 kHz 100 à 1 MHz 20 à 50 MHz	En mode +A et −B additionés; signal max. en mode commun: 8 div.
1.2.3. AXE HORIZONTAL OU X		
1.2.3.1. Modes de représentation	– Base de temps principale – Base de temps principale intensifiée par base de temps retardée – Base de temps retardée – Fonctionnement XY	 Déviation X par: – le signal voie A – le signal voie B – le signal appliqué au connecteur EXT de la base de temps principale – la fréquence secteur
1.2.4. BASE DE TEMPS PRINCIPALE		
1.2.4.1. Fonctionnements	Déclenché Automatique Balayage unique	En automatique, la base de temps est en fonctionnement libre en l'absence de signaux de déclenchement
1.2.4.2. Vitesses de balayage	1 s/div ... 50 ns/div	en 23 positions étalonnées (progression 1-2-5) Commande continue non-étalonnée 1 : ⩾ 2,5 entre les échelons par potentiomètre
1.2.4.3. Précision de mesure	±2 % ±3 %	entre +20 °C et +30 °C entre + 5 °C et +40 °C Cette précision de balayage, mesurée toutes les deux divisions sur 10 Div est de ±5 % à l'exclusion des premières et dernières divisions sur les positions 5 ns et 10 ns.

Désignation	Spécification	Information supplémentaire
1.2.4.4. Expansion de la vitesse de balayage		
Agrandissement	10x	commutable et étalonné
Erreur supplémentaire	±1 % 5 ns/div	Premières et dernières 50 ns de 5 ns, 10 ns et 20 ns agrandis sont exclues
1.2.4.5. Temps de blocage variable (hold off)	Le temps de blocage du balayage peut être augmenté par un facteur 10 environ	
1.2.5. BASE DE TEMPS RETARDEE		
1.2.5.1. Fonctionnement	La base de temps retardée est déclenchée par la base de temps principale immédiatement après le temps de retard choisi ou par le signal à examiner après le temps de retard (absence de jitter)	
1.2.5.2. Vitesses de balayage	0,5 s/DIV ... 50 ns/DIV	en 22 positions étalonnées (progression 1-2-5) Commande continue non-étalonnée 1 : ⩾ 2,5 entre les échelons par potentiomètre
1.2.5.3. Précision de mesure	±2 % ±3 %	entre +20 °C et +30 °C entre + 5 °C et +40 °C Cette précision de balayage, mesurée toutes les deux divisions sur 10 DIV est de 5 %, à l'exclusion des premières et dernières divisions sur les positions 5 ns et 10 ns.
1.2.5.4. Retard	Continuellement variable entre 0x et 10x le coefficient de temps de la base de temps principale	Etalonné dans le type standard PM 3260. Gamme de multiplicateur du temps de retard 0,00 - 9,99. Précision différentielle 0,5 %, typique 0,2 % Non-étalonné dans le type PM 3260E.
1.2.5.5. Instabilité du retard	< 1 : 20 000	Valeur typique 1 : 30 000
1.2.6. DEVIATION X		
Déviation X par Y_A		
1.2.6.1. Coefficient de déviation	5 mV/DIV à 2 V/DIV	Commande continue non-étalonnée ⩾ 3 : 1 par potentiomètre X AMPL.
1.2.6.2. Erreur de mesure	±5 %	
1.2.6.3. Bande passante	0 ... 2 MHz	−3 dB sur 8 DIV
1.2.6.4. Impédance d'entrée	1 MOhm//15 pF	
1.2.6.5. Déphasage	3° à 100 kHz	
Deviation X par Y_B		
Identique à la déviation X par voie Y_A, mais avec déviation du coefficient de ± 20 %.		
Déviation externe X par douille EXT		
1.2.6.6. Coefficient de déviation	300 mV/DIV	Une position calibrée Commande continue non-étalonnée ⩾ 3 :1 par potentiomètre
1.2.6.7. Bande passante	0 à 2 MHz	−3 dB sur 8 DIV
1.2.6.8. Caractéristiques d'entrée	mêmes que pour voies Y	
1.2.6.9. Déphasage	3° à 100 kHz	

Désignation	Spécification	Information supplémentaire
Déviation X avec tension interne à la fréquence secteur		
La déviation dépend de la tension secteur et est réglée à l'usine sur 8 DIV pour tension secteur 220 V.		
1.2.7. DECLENCHEMENT DE LA BASE DE TEMPS PRINCIPALE		
1.2.7.1. Source	Interne à partir de la voie A Interne à partir de la voie B Interne à partir du secteur Source externe	
1.2.7.2. Mode	Automatique	Fonctionnement automatique du générateur de base de temps environ 100 ms après la disparition du signal de déclenchement
	Levier manuel Balayage simple	
1.2.7.3. Polarité	+ ou –	
1.2.7.4. Sensibilité	Interne ⩽ 0,5 DIV Externe ⩽ 150 mV	Valeur typique en fonction de la fréquence, voir Fig. 1.3
1.2.7.5. Bande passante du filtre	DC: 0 - 120 MHz	Réponse uniforme, en interne et en externe
	LF: 0 - 30 kHz LF: 10 Hz - 30 kHz HF: 30 kHz - 120 MHz	–3 dB, interne –3 dB, externe –3 dB, interne et externe
1.2.7.6. Gamme de niveau	24 DIV –3,6 V à +3,6 V	Déclenchement interne Déclenchement externe
1.2.7.7. Caractéristiques d'entrée	Identique aux voies Y	
1.2.8. DECLENCHEMENT DE LA BASE DE TEMPS RETARDEE		
1.2.8.1. Source	Interne à partir de la voie A Interne à partir de la voie B Externe	
Les autres caractéristiques sont identiques à celles mentionnées au paragraphe 1.2.7. DECLENCHEMENT DE LA BASE DE TEMPS PRINCIPALE.		
1.2.9. UNITE D'ETALONNAGE		
1.2.9.1. Tension de sortie	3 V_{cc}	
1.2.9.2. Courant de sortie	6 mA	
1.2.9.3. Erreur limite	±1 %	Tension et courant
1.2.9.4. Fréquence	2 kHz ± 2 %	
1.2.9.5. Protection	La sortie est protégée contre des courts-circuits même continus.	
1.2.10. ALIMENTATION		
1.2.10.1. Tensions secteur	Toute tension comprise entre 100 et 240 V ±10 %	
1.2.10.2. Fréquence secteur	46 à 440 Hz	
1.2.10.3. Alimentation de sonde	+ et –24 V	sauf dans le type PM 3260E
1.2.10.4. Consommation	45 W	

Désignation	Spécification	Information supplémentaire
1.2.11. POSSIBILITES D'APPLICATION EN RAPPORT AVEC L'ENVIRONNEMENT		
1.2.11.1. Température ambiante	+5 °C ... +40 °C	Gamme nominale d'utilisation
	−10 °C ... +55 °C	Gamme limite de fonctionnement
	−40 °C ... +70 °C	Gamme d'emmagasinage et de transport
1.2.11.2. Altitude	5 000 m	Fonctionnement
	15 000 m	A l'arrêt
1.2.11.3. Humidité	L'appareil répond aux normes IEC 50 B (CO) 142	
1.2.11.4. Choc	L'appareil répond aux normes IEC 68 Eb	
1.2.11.5. Vibration	L'appareil répond aux normes IEC 68 F	
1.2.11.6. Temps de rétablissement	15 minutes (en fonctionnement normal)	quand l'appareil passe de −10 °C à +20 °C à 60 % d'humidité relative
1.2.12. CARACTERISTIQUES MECANIQUES		
1.2.12.1. Dimensions	Longueur 410 mm	Non compris commandes, couvercle et pieds
	Largeur 316 mm	
	Hauteur 154 mm	
1.2.12.2. Poids	9,3 kg	

1.2.13. ACCESSOIRES

1.2.13.1. Accessoires livrés avec l'appareil

Filtres de contraste
Couvercle frontal avec emplacements pour accessoires
Visière pliante PM 9366
Adaptateur BNC banane PM 9051
Borne CAL - Adaptateur BNC
Notice d'emploi et d'entretien
(Notice d'emploi en Francais, Notice de service en Anglais)

1.2.13.2. Accessoires en option

PM 9355	Sonde passive 1:1
PM 9351	Sonde passive 10:1
PM 9358	Sonde passive 100:1 haute tension
PM 9347*)	Sonde t.v. active
PM 9352*)	Sonde active miniature
PM 9353*)	Sonde F.E.T. active
PM 8960	Adaptateur pour montage en rack
PM 8971	Adaptateur de camera
PM 9380	Appareil de photographie d'oscillogrammes Gamme d'appareils Steinheil Oscillophot

*) L'alimentation pour sonde active PM 9346 est nécessaire lorsque ces sondes sont utilisées avec un oscilloscope du type PM 3260E.

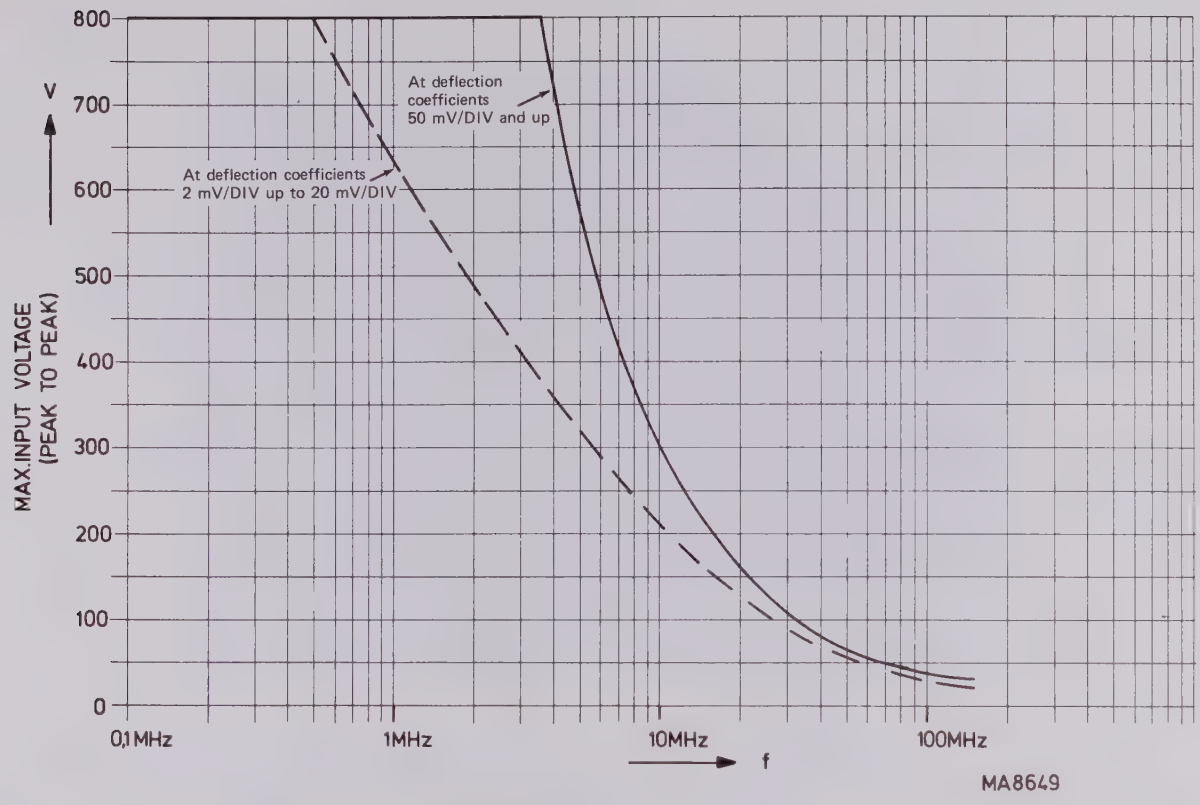

Fig. 1.2. Réduction de la tension d'entrée maximale admise

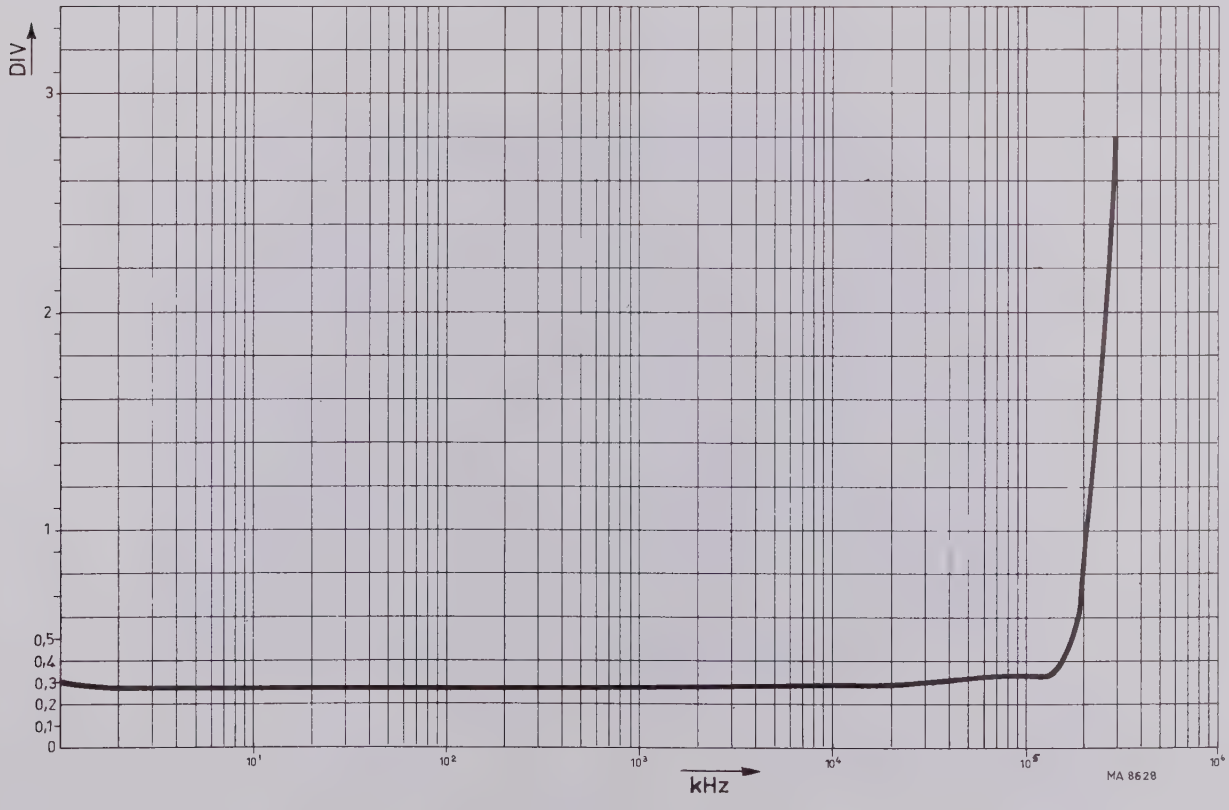

Fig. 1.3. Sensibilités typiques pour déclenchement interne et externe à partir de la voie A

Fig. 2.1. Dépose du couvercle frontal

Fig. 2.2. Vue arrière de l'appareil

2. Mode d'emploi

2.1. INSTALLATION

2.1.1. Démontage et montage du couvercle frontal

Démontage:
- Tourner le bouton au centre du couvercle d'un quart de tour vers la gauche (position UNLOCKED)
- Enlever le couvercle

Montage:
- Tourner le bouton de verrouillage vers position UNLOCKED
- Fixer le couvercle sur la partie avant de l'oscilloscope
- Enfoncer le bouton et le tourner d'un quart de tour vers la droite (position LOCKED).

Remarque: Pour faire pivoter la poignée, il faut enfoncer les boutons-poussoirs aux étriers.

Attention: Le présent appareil produit des tensions élevées et ne peut donc pas être utilisé avec les plaques du châssis déposées. La fiche secteur doit être enlevée et tous les points haute tension déchargés avant de procéder à n'importe quel travail d'entretien.

2.1.2. Adaptation à la tension secteur et fusible

La capacité d'utilisation à toute tension secteur comprise entre 90 et 264 V alternatif supprime la nécessité d'adapter le PM 3260 à la tension secteur locale.
La porte-fusible monté sur le panneau arrière porte un fusible à action retardée de 2 A. L'utilisation de fusibles réparés et le court-circuitage de porte-fusibles sont vivement déconseillés.

2.1.3. Mise à la terre

A des fins de sécurité l'oscilloscope doit être mis à la terre par l'intermédiaire de la borne prévue à cet effet située à l'arrière de l'appareil (reconnaissable au symbole ⏚) ou par l'intermédiaire du câble secteur, à condition que la fiche soit munie d'une connexion de terre.
Il faut veiller à ce que le conducteur de terre ne soit pas interrompu par l'usage d'un câble ou d'une unité de prolongement non-connectés à un conducteur de terre.

2.1.4. Enclenchement

Le commutateur POWER est incorporé dans la commande d'illumination de graticule ILLUM (panneau avant), juste sous le bord de l'écran.
L'oscilloscope ne doit jamais être enclenché lorsqu'une platine ou un bloc a été enlevé. Ne déposer de platine ou de bloc qu'une minute au moins après la mise hors service de l'oscilloscope.

2.2. UTILISATION

Avant d'enclencher, l'appareil, s'assurer qu'il est installé conformément à la section 2.1. INSTALLATION et que les précautions requises ont êtê prises.

2.2.1. Commandes et prises (Fig. 2.3.)

2.2.1.1. Voies verticales

A/ALT/CHOP/ADD/B	Commandes du mode d'affichage; sélecteur à 5 boutons-poussoirs
poussoir A enfoncé	La déviation verticale est obtenue seulement par le signal appliqué à l'entrée de la voie A.
poussoir ALT enfoncé	L'affichage est permuté d'une voie verticale à l'autre, et ce à la fin de chaque cycle du signal de base de temps.
poussoir CHOP enfoncé	L'affichage est permuté d'une voie verticale à l'autre à une fréquence fixe.
poussoir ADD enfoncé	La déviation verticale est obtenue par la somme des signaux A et B.
poussoir B enfoncé	La déviation verticale est obtenue seulement par le signal appliqué à l'entrée de la voie B. Si aucun bouton-poussoir n'est enfoncé, l'appareil fonctionne en mode ALT
POSITION	Commande continuellement variable pour le positionnement vertical des traces.
NORM/INVERT	Commutateur à 2 boutons-poussoirs pour l'inversion de la polarité de signal d'entrée sur l'écran. Si aucun bouton-poussoir n'est enfoncé, on obtient le même effet que si le bouton NORM était enfoncé.
AMPL.	Commutateur à 9 positions des coefficients de déviation verticale.
AMPL./CAL.	Commande continuellement variable des coefficients de déviation verticale. En position CAL. le coefficient de déviation est étalonné.
BAL (accessible par tournevis)	Commande continuellement variable pour l'équilibrage en tension continue des amplificateurs verticaux.
GAIN (accessible par tournevis)	Commande continuellement variable du gain des voies verticales.
AC/0/DC	Mode de couplage du signal d'entrée; commutateur à trois boutons-poussoirs.
AC enfoncé	Couplage par l'intermédiaire d'un condensateur de liaison.
0 enfoncé	La connexion entre l'entrée de l'amplificateur et la prise d'entrée est interrompue et l'entrée de l'amplificateur est mise à la terre.
DC enfoncé	Couplage direct Si aucun bouton n'est enfoncé, on obtient le même effet que lorsque le bouton AC est enfoncé.
A 1 MOhm - 15 pF	Prise d'entrée BNC pour voie A
B 1 MOhm - 15 pF	Prise d'entrée BNC pour voie B

2.2.1.2. Voie horizontale

DEL'D TB - EXT. X DEFL - MAIN TB	Commandes de la déviation horizontale; par commutateur à 3 boutons-poussoirs
poussoir DEL'D TB enfoncé	La déviation horizontale est fournie par le générateur de base de temps retardée.
poussoir EXT. X DEFL enfoncé	La déviation horizontale peut être obtenue par un signal d'origine extérieure appliqué à la prise d'entrée de l'amplificateur horizontal, par le signal de voie A, par le signal de voie B ou par un signal à la fréquence du secteur.

poussoir MAIN TB enfoncé — La tension de déviation horizontale est fournie par le générateur de base de temps principale.
Une partie de la trace est intensifiée (sauf en position OFF du commutateur TIME/DIV du générateur de base de temps retardée).
Si aucun bouton n'est enfoncé, on obtient le même effet que lorsque le bouton MAIN TB est enfoncé.

POSITION
TB MAGN — Commande continuellement variable pour le positionnement horizontal des traces; cette commande comprend un commutateur push-pull qui augmente le coefficient de déviation horizontale d'un facteur 10. Une lampe témoin indiquée x10 s'allume lorsque cette loupe est utilisée.

X AMPL/HOLD OFF — Commande continuellement variable des coefficients de déviation horizontale dans le cas de déviation par un signal extérieur.
Dans le cas de déviation X par la base de temps principale, cette commande peut être utilisée pour augmenter le temps de blocage du balayage.

2.2.1.3. Générateur de base de temps principale

LEVEL
SLOPE — Commande continuellement variable pour sélectionner le niveau du signal de déclenchement, auquel le générateur de base de temps principale démarre. Cette commande comprend un commutateur push-pull, qui permet de déclencher sur le front positif ou négatif du signal de déclenchement.

NOT TRIG'D — Lampe témoin qui s'allume lorsque le générateur de base de temps principale est en position d'attente.

AUTO - TRIG - SINGLE — Commande de mode de déclenchement; commutateur à trois boutons-poussoirs.

poussoir AUTO enfoncé — Le générateur de base de temps principale est en fonctionnement libre en l'absence de signaux de déclenchement.

poussoir TRIG enfoncé — Le générateur de base de temps est déclenché normalement.

poussoir SINGLE enfoncé — Le générateur de base de temps ne démarre qu'une seule fois à la réception d'une impulsion de déclenchement.
Si aucun bouton n'est enfoncé, l'appareil fonctionne en mode SINGLE.

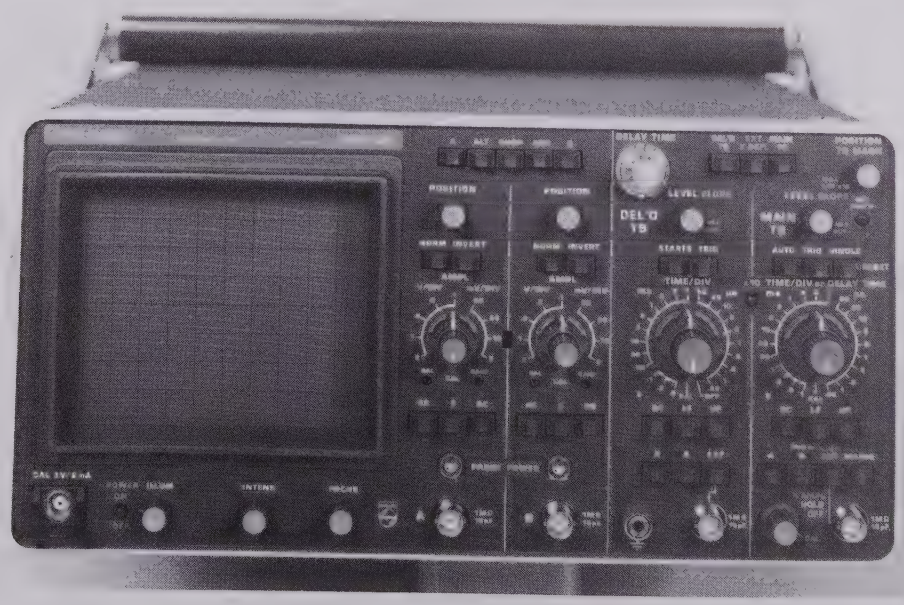

Fig. 2.3. Vue avant de l'appareil

TIME/DIV or DELAY TIME	Commande de la vitesse de balayage de la base de temps principale; commutateur rotatif à 23 positions.
TIME/DIV - CAL (bleu)	Commande continuellement variable de la vitesse de balayage de la base de temps principale. (En position CAL, la vitesse de balayage est étalonnées).
DC - LF - HF	Choix du couplage de déclenchement: commutateur à 3 positions
DC	Les signaux de déclenchement sont couplés directement.
LF	Couplage par le filtre passe-bas pour des fréquences allant jusqu'à 30 kHz (de 10 Hz à 30 kHz pour déclenchement externe).
HF	Couplage par un filtre passe-haut pour des fréquences supérieures à 30 kHz. Si aucun bouton-poussoir n'est enfoncé, on obtient le même effet que si la touche DC était enfoncée.
TRIG ou X DEFL	Commutateur à 4 boutons-poussoirs qui permet de sélectionner ou la source de déclenchement ou la déviation X par une source extérieure
poussoir A enfoncé	Signal de déclenchement interne ou de déviation X provenant de la voie A.
poussoir B enfoncé	Signal de déclenchement interne ou signal de déviation X provenant de la voie B.
poussoir EXT enfoncé	Déclenchement par un signal externe appliqué à la prise adjacente 1 MOhm - 15 pF. Lorsque le bouton EXT X DEFL des commandes de déviation horizontale est enfoncé, cette prise est connectée à l'entrée de l'amplificateur horizontal.
MAINS	Signal de déclenchement ou de déviation X provenant d'une tension interne à la fréquence du secteur. Si aucun bouton-poussoir n'est enfoncé, on obtient le même effet que si le bouton A était enfoncé.
1 MOhm - 15 pF	Prise BNC pour déclenchement externe ou déviation horizontale.

2.2.1.4. Générateur de base de temps retardée

DELAY TIME MULTIPLIER	Commande continuellement variable du temps de retard, utilisée en association avec les commandes TIME/DIV du générateur de base de temps principale.
LEVEL SLOPE	Commande continuellement variable qui permet de sélectionner le niveau du signal de déclenchement auquel le générateur de base de temps retardée démarre. Cette commande comprend un commutateur push-pull qui permet de démarrer sur le front positif ou négatif du signal de déclenchement.
STARTS - TRIG	Sélection du point de départ du générateur de base de temps retardée après le temps de retard; bouton-poussoir à deux positions.
STARTS	Le générateur de base de temps retardée est démarré immédiatement après le temps de retard.
TRIG	Le générateur de base de temps retardée ne démarre qu'après le temps de retard que lorsqu'elle reçoit une impulsion de déclenchement. Si aucun bouton-poussoir n'est enfoncé, on obtient le même effet que si la bouton STARTS était enfoncé.
TIME/DIV	Commande du coefficient de temps pour base de temps retardée; commutateur rotatif à 23 positions. Comprend une position OFF, grâce à laquelle le générateur de base de temps retardée est déclenché.
TIME/DIV - CAL (bleu)	Commande continuellement variable du coefficient de temps de la base de temps retardée. En position CAL, le coefficient de temps du commutateur est étalonné.
DC - LF - HF	Couplage de déclenchement; commutateur à 3 boutons-poussoirs.

DC	Les signaux de déclenchement sont couplés directement.
LF	Couplage par un filtre passe-bas pour les fréquences jusqu'à 30 kHz (pour le déclenchement par un signal exterieur, le filtre passe-bas agit de 10 Hz à 30 kHz)
HF	Couplage par un filtre passe-haut pour fréquences supérieure à 30 kHz. Si aucun bouton n'est enfoncé, on obtient le même effet que si le bouton DC était enfoncé.
A - B - EXT	Commande de la source de déclenchement; commutateur à 3 boutons-poussoirs.
A	Signal de déclenchement interne prélevé de la voie A
B	Signal de déclenchement interne prélevé de la voie B
EXT	Déclenchement par application d'un signal externe à la douille adjacente 1 MOhm - 15 pF. Si aucun bouton n'est enfoncé, on obtient le même effet que si le bouton A était enfoncé.
1 MOhm - 15 pF	Prise d'entrée BNC pour le signal de déclenchement externe.

2.2.1.5. Tube à rayons cathodiques

ILLUM POWER	Commande continuellement variable de l'illumination de graticule; comprend le commutateur secteur. La lampe témoin indique la position ON.
INTENS	Commande continuellement variable pour la brillance de la trace.
FOCUS	Commande continuellement variable pour la focalisation du faisceau.

2.2.1.6. Divers

CAL	Prise de sortie sur laquelle une tension rectangulaire de 3 V_{cc} et un courant de 6 mA sont disponibles à une fréquence de 2 kHz. Précision d'amplitude: ±1 % Précision de fréquence: ±2 % La sortie est protégée contre les courts-circuits continus.
PROBE POWER	Prises pour alimentation d'accessoires actifs; tension délivrée +24 V et −24 V.
⏚	Douille de terre de mesure

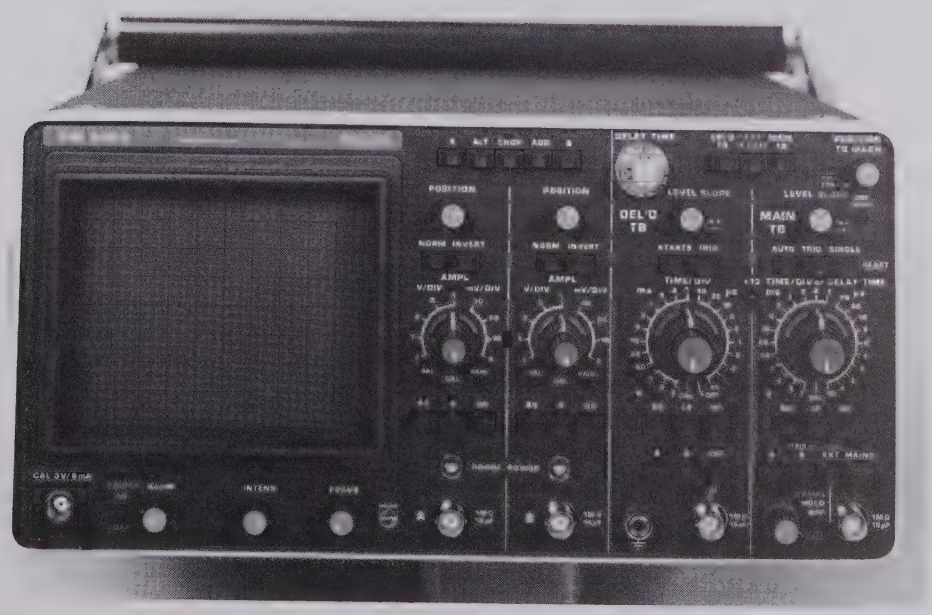

Fig. 2.3. Vue avant de l'appareil

2.2.2. Réglages préliminaires

Etant donné que les réglages suivants sont identiques pour les deux voies verticales, seul le processus pour la voie A est décrit.

2.2.2.1. Réglage de la balance continue

- Actionner le bouton-poussoir A des commandes de mode d'affichage.
- Actionner le bouton-poussoir AUTO des commandes de mode de déclenchement.
- Actionner le bouton-poussoir MAIN TB des commandes de déviation horizontale.
- Régler le commutateur AMPL sur 5 mV et la commande continue sur CAL (étalonnée).
- Centrer la trace avec la commande POSITION.
- Régler les commandes INTENS et FOCUS afin d'obtenir une trace nette et fine.
  Les commandes non-mentionnées peuvent occuper n'importe quelle position.
- Vérifier si la trace ne saute pas lorsque le commutateur AMPL est commuté entre les positions 5 et 10 mV.
  Au besoin, rajuster la commande BAL sur le panneau avant placée immédiatement sous la commande AMPL.

2.2.2.2. Réglage du gain

Sauf indications contraires, les commandes occupent la même position que pour le processus de réglage précédent.

- Régler le commutateur AC-0-DC sur DC.
- Régler le commutateur AMPL sur .5 V et la commande continue sur CAL (étalonnée).
- Connecter la prise d'étalonnage CAL à la prise d'entrée A.
- Vérifier si la hauteur de trace est exactement de 6 divisions.
  Au besoin, rajuster la commande GAIN sur le panneau avant, juste sous le commutateur AMPL.

2.2.3. Entrées A et B et leurs possibilités

L'oscilloscope est pourvu de deux voies identiques, toutes deux pouvant être utilisées soit pour des mesures YT avec un ou deux générateurs de base de temps, soit pour des mesures XY avec la voie horizontale externe.

2.2.3.1. Mesures YT

Pour afficher un signal d'une des voies verticales, il suffit d'actionner le bouton-poussoir A ou B des commandes de mode d'affichage.
Lorsque le bouton-poussoir ALT ou CHOP est enfoncé, deux signaux différentes peuvent être affichés simultanément. Le coefficient de déviation Y et la polarité peuvent être sélectionnées pour chaque voie séparément. Lorsque le bouton ALT est actionné, l'affichage est commuté d'une voie à l'autre au retour du signal de base de temps.
Quoique le mode ALTERNATE puisse être utilisé à toutes les vitesses de balayage du générateur de base de temps, le mode CHOPPED donne une meilleure qualité d'affichage pour des vitesses de balayage lents en effet pendant les temps de balayage longs, l'affichage alterné des deux signaux d'entrée est visible.

En mode CHOPPED, l'affichage est permuté d'une voie à l'autre à une fréquence fixe.
Si le bouton-poussoir ADDED du commutateur de mode d'affichage est actionné, les signaux des deux voies verticales sont additionnées. En fonction des positions des commutateurs de polarité, la somme ou la différence des signaux d'entrée est affichée. Le mode ADDED permet également des mesures différentielles.
Lorsque les commutateurs de polarité des deux voies sont mis en positions opposées, les parties mode commun des signaux aux prises A et B subissent une très légère amplification par rapport aux parties de mode différentiel.

2.2.3.2. Mesures XY

Si les boutons-poussoirs EXT X DEFL des commandes de déviation horizontale et A des commandes TRIG OR X DEFL sont actionnés, les générateurs de base de temps sont déconnectés. Un signal appliqué à la voie verticale A est alors utilisé pour la déviation horizontale. Le commutateur AC/0/DC et l'atténuateur par échelons de la voie A restent en service. La commande continue des coefficients de déviation est possible avec la commande X DEFL/HOLD OFF et le décadrage de la trace horizontale avec la commande X POSITION.

La voie verticale B peut également être utilisée pour la déviation X pour ce faire, le bouton B des commandes TRIG OR X DEFL doit être enfoncé.
Pour la déviation X, il est également possible d'utiliser une tension interne à la fréquence du secteur ou un signal extérieur appliqué à la douille EXT située sur la partie inférieure droite du panneau avant ceci, après avoir enfoncé le bouton-poussoir correspondant des commandes TRIG OR X DEFL. Dans ces modes la largeur de trace peut être commandée avec le potentiomètre X DEFL/HOLD OFF. Lorsque ce potentiomètre est en position CAL, le coefficient de déviation pour un signal extérieur est de 300 mV/DIV.

2.2.3.3. Commutateur AC/0/DC

Les signaux observés sont appliqués aux prises d'entrées A et/ou B et le commutateur AC/0/DC est réglé soit sur AC soit sur DC en fonction de la composition du signal. Du fait que l'amplificateur vertical est couplé directement, tout la bande passante de l'appareil est disponible et le composantes continues sont affichées comme des décalages de trace en position DC du commutateur AC/0/DC. Ceci peut ne pas convenir lorsque de petits signaux superposés à des tensions continues doivent être représentés. Chaque atténuation du signal résulte en une atténuation de la petite composante alternative.
Le remède à cet état est d'utiliser la position AC du commutateur d'entrée, lequel comprend un condensateur de liaison servant à supprimer les signaux continus et basse fréquence. Lorsque des signaux rectangulaires à basse fréquence sont représentés, on obtient une certaine pente de toit.

En position 0 le signal est interrompu et l'entrée de l'amplificateur est mise à la terre, sur cette position, le niveau 0 V est rapidement déterminé.

2.2.4. Déclenchement

Lorsqu'un signal doit être représenté, la déviation horizontale doit toujours être démarrée à un point fixe du signal, et ce afin d'obtenir une trace stationnaire. Le générateur de base de temps est donc démarré par des impulsions de déclenchement étroites produites dans l'unité de déclenchement et commandé par un signal qui peut provenir: d'un des signaux appliques aux entrées verticales, d'une tension interne à la fréquence du secteur, ou une source extérieur.

2.2.4.1. Couplage de déclenchement

Trois méthodes de couplage de déclenchement sont possibles avec le commutateur DC/LF/HF. En positions HF et LF, la caractéristique de transfert est limitée.
En position DC, le signal de déclenchement reste inchangé.
En position LF, un filtre passe-bande de 0 Hz (10 Hz pour déclenchement externe) à 30 kHz est incorporé.
Cette position peut être utilisée pour réduire l'interférence du bruit.
En position HF, un filtre passe-haut de 30 kHz est incorporé.
Cette position peut être utilisée pour réduire l'interférence du ronflement par exemple.

2.2.4.2. Sélection de la source de déclenchement et réglage du niveau de déclenchement

Le signal de déclenchement est obtenu à partir de la voie A (bouton A enfoncé), de la voie B (bouton B enfoncé), d'une source externe (bouton EXT enfoncé) ou d'une tension interne à la fréquence du secteur (bouton MAINS enfoncé).
Le conformateur d'impulsions de déclenchement est un multivibrateur à double commande commuté par les signaux de sortie d'un amplificateur différentiel.
Le signal de déclenchement, sur lequel la commande continue AMPL n'a pas d'effet, est appliqué aux entrées de l'amplificateur différentiel de concert avec les tensions continues réglables avec le potentiomètre LEVEL.
En fonction du réglage LEVEL, une certaine partie du signal de déclenchement est amplifiée par l'amplificateur différentiel.
Le multivibrateur est donc commuté à un point fixe du signal de déclenchement (voir Fig. 2.4.). Ceci signifie que, s'aidant de la commande LEVEL, il est possible de donner sa forme au signal de déclenchement (en cas de déclenchement interne A ou B égal à la forme du signal à représenter) et donc, de choisir le point où le multivibrateur sera commuté.
Le potentiomètre LEVEL est pourvu d'un commutateur push-pull qui permet la sélection de la pente de déclenchement.

2.2.4.3. Déclenchement automatique

Lorsque le bouton AUTO du commutateur AUTO - TRIG - SINGLE est enfoncé, et qu'aucune impulsion de déclenchement n'est disponible, le générateur de base de temps fonctionne librement.
La trace est alors toujours visible. Le mode AUTO peut être utilisé dans tous les cas où le mode TRIG est également applicable, à l'exception de signaux dont la fréquence est inférieure à 10 Hz et des trains d'impulsions ayant un temps supérieur à 100 ms.
Dès que des impulsions de déclenchement sont disponibles, le fonctionnement libre du générateur de base de temps est automatiquement achevé et le générateur est à nouveau déclenché comme décrit aux paragraphes 2.2.4.1. et 2.2.4.2.
Lorsque les boutons TRIG ou SINGLE sont actionnés, le circuit automatique est mis hors circuit. Le réglage LEVEL peut également être utilisé en mode AUTO.

2.2.4.4. Déclenchement du balayage en SINGLE

Lorsque des effets uniques sont observés (par photographie), il faut s'assurer qu'une seule dent de scie est engendrée, même si plusieurs impulsions de déclenchement doivent être produites après le phénomène en question. Il va de soi que la dent de scie simple en question doit être déclenchée par une impulsion de déclenchement. Pour ce faire, le bouton SINGLE doit être enfoncé. La première impulsion de déclenchement apparaissant après le relâchement du bouton démarre le générateur de base de temps, celui ci est alors bloqué jusqu'à ce que le bouton SINGLE soit enfoncé à nouveau. La lampe NOT TRIG'D s'allume dès que le bouton SINGLE est relâché, et ce jusqu'à la fin de la dent de scie.

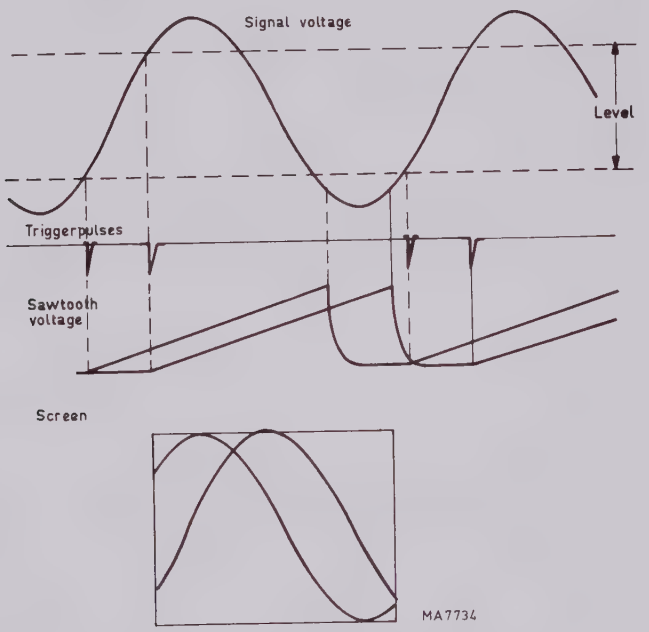

Fig. 2.4. Analyse de la forme d'onde à l'aide du potentiomètre LEVEL

2.2.5. Agrandisseur de base de temps MAGN

L'agrandisseur de base de temps est actionné par un commutateur push-pull à deux positions incorporé dans la commande POSITION horizontale. Lorsque ce commutateur est tiré en position x10, les vitesses de balayage du générateur de base de temps principale sont augmentées d'un facteur 10. Donc, en x1, (TB MAGN enfoncé) la portion du signal affichée sur une largeur égale à une division au centre de l'écran occupe la largeur totale de l'écran en position x10. Chaque portion de la trace peut être rapportée sur l'écran à l'aide de la commande de POSITION horizontale.
En position x10, le coefficient de temps est déterminé en divisant par 10 la valeur TIME/DIV.
Un voyant lumineux rouge indique à l'opérateur qu'il utilise la position x10.

2.2.6. Utilisation de la base de temps retardée

La base de temps retardée peut être utilisée pour l'étude précise de signaux complexes. Lorsque le bouton-poussoir STARTS de la commande STARTS/TRIG est actionné, la base de temps retardée est immédiatement enclenchée (le commutateur TIME/DIV n'est pas sur OFF) et une portion du signal affiché est intensifiée en position MAIN TB des commandes de déviation horizontale. La commande DELAY TIME permet de décaler cette partie intensifiée le long de l'axe des temps. La durée de cette portion intensifiée ainsi que sa longueur peuvent être commandées par échelons et ce de façon continue à l'aide des commandes TIME/DIV du générateur de base de temps retardée. Lorsque le bouton-poussoir DEL'D TB des commandes de déviation horizontale est enfoncé, la portion intensifiée occupe la largeur totale de l'écran. En position DEL'D TB, le retard (c.à.d., l'intervalle entre le point de démarrage de la base de temps principale et le point de démarrage de la base de temps retardée) est déterminé par les réglages des commandes TIME/DIV principales et de la commande DELAY TIME.

Lorsque le bouton TRIG de la commande STARTS/TRIG est enfoncé, la base de temps retardée est démarrée par la première impulsion de déclenchement qui apparaît après le retard sélectionné. Cette impulsion de déclenchement est produite par l'impulsion de déclenchement du générateur de base de temps retardée. Cette position est utilisée pour éviter une instabilité de la base de temps, laquelle donne une représentation floue d'un détail. Cette instabilité peut faire partie du signal à analyser ou, pour des agrandissements extrêmes, être produite dans les circuits de base de temps.

Service manual

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3. Service manual

3.1. DESCRIPTION OF THE BLOCK DIAGRAM

3.1.1. General information

The PM 3260 oscilloscope comprises the following parts:
- a dual-channel vertical system
- a main time-base
- a delayed time-base
- a switching unit
- an X amplifier
- a Z amplifier
- a c.r.t. circuit
- a stabilized power supply

3.1.2. Dual-channel vertical system

Both vertical channels contain identical circuits. An input signal to one of the channels is, via a coupling switch AC/0/DC, applied to the input attenuator. In the AC position of the coupling switch there is a capacitor in the signal path. In the DC position the coupling is direct.
If the coupling switch is set to the 0 position, the connection between the input socket and the attenuator input is interrupted, the latter being earthed.

The input attenuator, which is controlled by the AMPL switch, enables the adjustment of the vertical-deflection sensitivity in calibrated steps.

The attenuator is followed by a low-drift impedance converter which gives the input circuit a high input impedance.
The impedance converter also contains a voltage divider which works in conjunction with the input attenuator. The d.c. balance of the entire channel is set by compensating for the d.c. offset voltage of the impedance converter by means of the BAL potentiometer.

The signal that leaves the impedance converter on a 50 Ohm level is applied to a paraphase amplifier where it is transformed into a push-pull signal. The paraphase amplifier has two outputs. From one of these outputs the signal is applied to a trigger pre-amplifier and from the other one to an amplifier stage. This stage comprises the switch NORMAL/INVERT by means of which the phase of the signal can be inverted, and a GAIN pre-set potentiometer which allows the overall gain of the channel to be set.

The following stage is a channel selector which either blocks or passes the signal as dictated by the channel selector logic. The channel selector also comprises the controls for vertical trace positioning.
In the A, B and ADD modes the channel selector logic is set by means of voltage levels and in the ALT and CHOP mode controlled by pulses. In the ALT mode those pulses are supplied by the sweep-gating multivibrator of the main time-base generator during the flyback of the sweep, so that alternately the complete signals of channel A and channel B are displayed.
In the CHOP mode the drive pulses are provided by an oscillator which works at a fixed frequency of approximately 1 MHz.
Those pulses cause the electronic switches in the channel selector to be successively opened and closed so that successively part of the signal of channel A and of channel B are displayed.

After the channel selector, the following circuits are common to both vertical channels.
A delay line that delays the vertical signals to such an extent that the steep leading edges of fast signals are still displayed, a correction circuit in which the losses caused by the delay line are compensated for, and a final output stage which feeds the signals to the vertical-deflection plates.

3.1.3. Time bases

3.1.3.1. Main time-base

The trigger source/X deflection selector receives its signal from one of the vertical channels, from the attenuator/impedance converter for external trigger or X deflection signals, or from the power supply (MAINS). One of those signals can be selected by operating one of the controls incorporated in this stage.

From the selector stage the signal is fed to either the X amplifier for horizontal deflection, or the trigger amplifier for starting the time-base generator. The amplifier is a differential one, containing the controls for trigger-level adjustment, slope selection and coupling selection. By means of the coupling control, the input frequency range of the trigger circuit can be set. The slope selector allows the polarity of the trigger signal to be inverted, enabling triggering on the positive as well as on the negative slope of the input signals.

From the amplifier the trigger signal is applied to the trigger multivibrator that supplies well-defined trigger pulses. These trigger pulses are used to switch the sweep-gating multivibrator and, when the AUTO push-button has been operated, for driving the automatic circuit.

The sweep-gating multivibrator starts and stops the integrator which delivers the sawtooth signal required for the horizontal deflection. The integrator comprises the charging capacitors and resistors selected by the TIME/DIV switch in order to set the time coefficients in calibrated steps. Continuous control of the time coefficients is obtained by varying the charging current of the time determining capacitors by means of the TIME/DIV potentiometer.

The amplified output signal of the integrator is fed to the X deflection selector, the hold-off multivibrator and the comparator which is part of the delayed time-base unit. The hold-off multivibrator switches back the sweep-gating multivibrator and blocks its input during the flyback of the sawtooth signal. The hold-off circuit also incorporates the single-sweep circuit which causes the main time-base to deliver only one sawtooth pulse, after the SINGLE button has been depressed and upon receipt of a trigger pulse.

The automatic free-run circuit or auto-circuit makes the time-base generator free-running when there are no trigger pulses.

3.1.3.2. Delayed time-base

The delayed trigger-unit and time-base generator comprise in principle the same circuitry as the main trigger-unit and time-base generator. The delayed time-base works always in the single-shot mode. It is started by the main-time-base generator which also serves as hold-off circuit for the delayed time-base.

The DELAY TIME MULTIPLIER control, the comparator and the reset multivibrator determine the delay time for the delayed time-base generator. The operating modes of the delayed time-base generator can be selected by means of the STARTS/TRIG switch. If the STARTS push-button is depressed, the delayed time-base generator starts immediately after the delay time. When the TRIG button is operated, however, the delayed time-base is started upon receipt of the first trigger pulse after the delay time.

When push-button MAIN TB of the horizontal deflection mode controls has been depressed, the part of the trace coinciding with the delayed sweep is intensified, except in the OFF position of the delayed TIME/DIV switch.

3.1.4. Switching unit and X amplifier

Apart from the blanking pulse selector and the X deflection selector, the switching unit comprises an amplifier for external X deflection signals and an intermediate amplifier. The X deflection selector couples the external X deflection signal, the output signal of the main time-base generator or the combined output signals of the main and delayed time-base generators to the intermediate X amplifier and from there, via the final amplifier, to the horizontal-deflection plates. The intermediate amplifier comprises the horizontal trace positioning and 10x magnification controls.

The blanking pulse selector supplies blanking pulses to the Z amplifier. These pulses blank the trace at the end of the sweep of the main time-base and provide the extra bright-up pulse if the oscilloscope operates with a portion of the trace intensified. The blanking pulses during the switching of the traces in the chopped mode go direct from the channel selector logic to the Z amplifier.

3.1.5. Z Amplifier and c.r.t. circuit

The Z amplifier receives two input signals. One originates in the time-base generator and is, via the switching circuit, applied to the Z amplifier to blank the trace during the flyback.
The other one is supplied by the channel selector logic to blank the trace during switching from channel to channel in the chopped mode. The INTENS potentiometer determines the amount of input current fed to the Z amplifier. At the output of the amplifier, the signal is split into two parts: an l.f. + d.c. part and an h.f. part. The h.f. part is fed direct to the Wehnelt cylinder of the c.r.t. The l.f. + d.c. part is modulated on to an oscillator signal and afterwards detected in a peak-detector. Both signal parts are combined again on the Wehnelt cylinder.

The focus voltage for the c.r.t. is generated in an oscillator. The output voltage of the oscillator is rectified, multiplied by a factor of 5 and applied to the focussing anode. The focussing voltage is controlled by the FOCUS potentiometer which is electronically coupled with the INTENS potentiometer. In this way, defocussing due to operation of the INTENS potentiometer is largely obviated.

The high voltage for the post-acceleration anode of the c.r.t. is supplied by a stabilized oscillator whose output voltage is rectified and multiplied by a factor of 9.

Furthermore, the c.r.t. circuitry comprises preset potentiometers for trace rotation, astigmatism, distortion and orthogonality.

3.1.6. Stabilized power supply

The mains voltage is full-wave rectified and fed to a voltage regulator.
The rectified mains voltage controls a blocking oscillator which generates a voltage at a frequency of approximately 20 kHz. This voltage is applied to the primary of a transformer.
The secundary voltages of this transformer are full-wave rectified, smoothed and applied to the various circuits.

The MAINS triggering signal is taken direct from the mains and, via an opto-isolator, fed to the trigger circuitry on a safe level.
The calibrator is a square-wave generator which supplies an accurate voltage and current for calibration purposes.

3.2. CIRCUIT DESCRIPTION

3.2.1. Vertical deflection system

3.2.1.1. Input stage

The input stage comprises two identical units: the input attenuators. Each attenuator consists of a triple high-ohmic voltage divider and an impedance converter. The impedance converter has three outputs at different signal levels.

The total attenuation of the input stage is determined by the combination of the relevant section of the voltage divider and the relevant output of the impedance converter.
Reed relays switch in the various combinations as dictated by the position of the attenuator switch on the front panel.

The high-ohmic voltage divider sections attenuate (from top to bottom in the circuit diagram) 1x, 10x and 100x.
In combination with R112 the attenuation is 1,25x, 12,5x and 125x. Output 2 of the impedance converter gives an attenuation of 1x, output 3 of 2x and output 4 of 4x.
With the combination of the attenuators before and after the impedance converter, nine deflection coefficients from 5 mV/DIV to 2 V/DIV in 1-2-5 sequence are realized.

The input capacitance of the oscilloscope is kept constant for the various attenuator positions by means of trimmers C102, C107 and C111. The high-ohmic voltage divider sections are made independent of the frequency (i.e. the capacitive attenuation for a.c. signals is equalized to the resistive attenuation for d.c. signals) by means of trimmers C101, C108 and C109.

The input source-follower, TS101 of the impedance converter is protected by diode GR101. If there is a maximum positive-going voltage change, the field-effect transistor can deal with it. If the change goes negative beyond the threshold established by diode GR101, the latter starts conducting and the excess voltage is short-circuited.

The BAL potentiometer, which can be adjusted on the front panel, keeps the input circuit balanced in the various positions of the high-ohmic voltage divider.

The output impedance of the impedance converter is 50 Ohm in all attenuator positions. In this way, a correct match is obtained for the coaxial cable to the intermediate amplifier.

The input attenuators also comprise the input-coupling switches which are operated via reed relays. In the AC position, capacitor C104 is in the circuit, reducing the lower frequency limit to 10 Hz.

3.2.1.2. Intermediate amplifier

The intermediate amplifier consists chiefly of circuit blocks. In this way, a great stability is obtained for temperature, drift and tolerances. As the channel A and channel B signal paths are identical, only the channel A signal path will be described.

The output signal of the channel A input stage is directly applied to point 12 of circuit block IC352 (AMPLIFIER I).
Transistors TS351 and TS352 are constant current sources for this circuit block. On points 13 and 15 of the latter, the h.f. response is corrected by means of RC networks with C356, C357, C358 and C359, and R363B, R364 and R366. The response to very high frequencies is controlled with potentiometer R368, via point 14 of the circuit block.

Circuit block AMPLIFIER I has two pairs of symmetrical outputs: one to the next amplifier of the Y signal and a second one to the trigger pre-amplifier.

The Y output signal of circuit block IC352 (AMPLIFIER I) is applied to circuit block IC354 (AMPLIFIER II), points 11 and 15. In this amplifier, the overall gain of the channel is adjustable by means of GAIN potentiometer R16, which is connected to point 10 of the AMPLIFIER II block via the continuous control of the Y deflection coefficients R11.

Both potentiometers can be operated on the front panel.
Possible unbalance due to readjustment of the GAIN potentiometer can be compensated for with the GAIN BAL potentiometer R361, which alters the bias of current source TS351 of the AMPLIFIER I circuit block.

To points 7 and 19 of the AMPLIFIER II block, a circuit with transistors TS353, 354 and 356, diode GR351 and integrated circuit IC353 has been connected. IC353 is an operational amplifier.
The circuit, which is controlled by the AMPL potentiometer, sets the gain of AMPLIFIER II by means of a diode bridge between the two balanced signal paths. The dynamic resistance of the diode bridge varies when the AMPL potentiometer is rotated. In this way a smaller or larger part of the symmetrical signal is 'short-circuited'. IC353 gives this control a high stability, by keeping the ratio between the control current of the diodes and the signal current at a constant value.

NORM/INVERT switch SK6 has been connected to points 2 and 24 of the AMPLIFIER II block, via resistors R388 and R389.
This switch allows the Y signal of the A channel to be inverted in polarity. Possible unbalance between the two positions of this switch can be compensated for by means of pre-set potentiometer R383.

The output signal of the AMPLIFIER II block is fed to points 14 and 12 of circuit block IC306 (CHANNEL SELECTOR). In this circuit block, the signals of channels A and B are joined together again, the channel B signals being applied to points 27 and 29. The output signal of the CHANNEL SELECTOR block on points 19 and 21 is connected to delay line L301, via 50 Ohm cables. This output signal can be: the channel A signal only, the channel B signal only and channels A and B added, chopped or alternated, as dicated by the control signal on points 4 and 7 of the CHANNEL SELECTOR block. The control signal originates in the CHANNEL SELECTION LOGIC which is described in section 3.2.1.3.

Point 5 of the CHANNEL SELECTOR block is connected to a supply voltage delivered by emitter follower TS311. If push-button ADDED of the display-mode controls is depressed, this voltage is higher, as both channels are then switched in at the same time.

The position of the displays of both channels is also controlled in the CHANNEL SELECTOR block. The controls are POSITION potentiometers R3 and R7, operated on the front panel of the instrument.

The last circuit block of the intermediate amplifier is IC351 (TRIGGER), the trigger pre-amplifier for channel A. The channel B trigger pre-amplifier is identical TRIGGER block IC301. The input of the TRIGGER block, points 27 and 29, is connected to the symmetrical output of AMPLIFIER I block IC352, points 27 and 29.

The TRIGGER block has two symmetrical outputs. One output, points 12 and 15, is connected to the trigger circuit of the main time-base generator, whereas the other one, points 11 and 14 is connected to the delayed time-base trigger circuit.
The output signals must be symmetrical and on zero-volt levels.
The symmetry can be set by means of potentiometer R351 and the zero-volt level with the aid of potentiometer R354.

3.2.1.3. Channel selection logic

The channel selection logic consists of digital circuits comprising standard dual-in-line integrated circuits IC1601, IC1602 and IC1603. The outputs 3 and 6 of IC1602 are connected to inputs 4 and 7 of CHANNEL SELECTOR block IC306. The logic levels in this digital circuit are: logic '1' is +5 V and logic '0' is 0 V.
If output 6 of IC1602 is high (logic 1), channel A is switched in. The same is true for output 3 of IC1602. If this point is logic 1, channel B is switched in. The levels on outputs 3 and 6 of IC1602 are determined by JK flip-flop IC1603.

In the following we shall discuss the different functions of the logic circuit on the basis of the positions of the display-mode controls.

If SK1 (A) is depressed, channel A only, input 2 of the JK flip-flop is low and consequently its output 6 is high. As a result of this, output 3 of IC1602 is low and channel B is blocked. Output 8 of the JK flip-flop is low and consequently output 6 of IC1602 is high: channel A is switched in.

If SK1 (E) is depressed, channel B only, input 13 of the JK flip-flop is low and consequently its output 8 is high. As a result of this, output 6 of IC1602 is low and channel A is blocked. Output 6 of the JK flip-flop is low and consequently output 3 of IC1602 is high: channel B is switched in.

SK1 (D) depressed: channels A and B added. Then both input 5 and input 2 of IC1602 are low and consequently both output 6 and output 3 are high: both channels are switched in.

SK1 (C) depressed: channels A and B chopped. In this position a chopper generator is switched into the circuit. The generator consists of parts of IC1601. Between points 2 and 3, and 2 and 6 of IC1601, there is a feedback loop.
This means that the circuit starts oscillating when input 1 of IC1601 is high, the oscillation frequency being 2 MHz.

Via points 9 and 8 of IC1602 and 9 and 8 of IC1601, this 2 MHz signal is fed to trigger input 12 of JK flip-flop IC1603. This flip-flop is then set and reset at a frequency of 1 MHz. The 1 MHz output signal appears in turn on inputs 4 and 1 of IC1602. Consequently outputs 3 and 6 of IC1602 are in turns high, thus providing the chopped control signal for the CHANNEL SELECTOR block IC306.

During the switching over in the CHOP mode, the c.r.t. is blanked with the aid of pulses supplied by transistors TS1602, TS1603 and TS1604. Normally these transistors are always bottomed via resistor R1608. In the CHOP mode, however, the negative-going edges of the 2 MHz chopper signal are differentiated via C1603. As a result, positive pulses arise on the collector of TS1602. These pulses are fed to the Z amplifier via transistor TS1603.

SK1 (B) depressed: channels A and B alternately displayed.
This push-button is a dummy and has no contacts, but it releases all the other push-buttons of the display-mode controls.
In this mode, input 13 of IC1601 carries the collector signal of transistor TS1601. The hold-off pulse of the main time-base generator is fed to the base of this transistor.
During the sweep, this pulse is approximately 0 V and during the hold-off period it is positive. Consequently, the hold-off pulses are present on the collector of TS1601 and, therefore, on input 13 of IC1601. These pulses are, via output 11 of IC1601, fed to input 10 of IC1601. From output 8 of this IC, the inverted signal is applied to trigger input 12 of JK flip-flop IC1603. As a result of this, the flip-flop is set and reset by a signal which is a replica of the main time-base hold-off pulses. Outputs 6 and 3 of IC1602 are in turns high and low and the input signal of the oscilloscope is alternately displayed by channels A and B.

3.2.1.4. Final Y amplifier

The final Y amplifier comprises three circuit blocks IC401, IC402 and IC403 and two output transistors TS401 and TS402. The output signal of the delay line is applied to inputs 18 and 23 of circuit block IC401 (DELAY LINE CORRECTION AMPLIFIER), via 50-Ohm coaxial cables.
As the delay line is a source of distortion for higher frequencies, there is a h.f. correction network included between the delay line and circuit block IC401. This network consists of capacitors C400 ... C407 and resistors R403 ... R408. Correction of the highest frequencies is possible with the aid of varicap diodes which are incorporated in the DELAY LINE CORRECTION AMPLIFIER block. The bias of the varicap diodes is set by means of pre-set potentiometers R409 and R410.

The DELAY LINE CORRECTION AMPLIFIER block is provided with two symmetrical outputs: 12-15 and 11-14. Output 12-15 is connected to input 26-30 of circuit block IC402 (FINAL AMPLIFIER) and output 11-14 is connected to the same input of a similar circuit block IC403 (FINAL AMPLIFIER).

The outputs of the FINAL AMPLIFIER blocks are connected in parallel and symmetrically applied to output transistors TS401 and TS402.
The overall gain of the final amplifier can be set by means of potentiometer R432 which controls the voltage on point 27 of circuit block IC401 (DELAY LINE CORRECTION AMPLIFIER).

The collectors of the output transistors are connected to the Y deflection plates of the c.r.t. Each Y deflection plate consists of four parts which form filters together with coils L401 ... L409 and the stray capacitances of the deflection plates. The constants of this filter network are chosen in such a way that the propagation velocity of a pulse equals the velocity of the electron beam. In this way transit-time distortion is kept to a minimum. The filter chain terminates in resistors R418 ... R431. The termination is optimized by means of potentiometer R423.

3.2.2. Triggering of the main time-base generator

The trigger unit of the main time-base generator has four input sources, viz. an external source, part of the signal of channel A, part of the signal of channel B or the mains. These sources can be used for both triggering and X deflection. Source selection is made with the aid of current sources that drive a symmetrical circuit.

3.2.2.1. Trigger input circuits and amplifier

A signal on EXT trigger socket BU8 is applied to the gate of input field-effect transistor TS601A, via voltage divider R601-R602 and capacitor C610. The gate of the field-effect transistor is protected against overload by means of two sets of two diodes in series, which limit the gate voltage to + and −1,4 V.

With the aid of DC switch SK19 selection is possible between a.c. and d.c. coupling of the input signal. If SK19 is depressed, resistors R606 and R607 bypass capacitor C610 with the result that also d.c. voltages are applied to the gate of field-effect transistor TS601A. Capacitor C607 suppresses possible interference signals that might be picked up by the long lead between switch SK19A on the front panel, and the trigger unit.

Constant current source TS601B serves to get a fictive d.c. zero at the base of TS608.

The output signal of field-effect transistor TS601A is applied to the base of transistor TS608. This transistor is, together with transistor TS604, switched in by current source TS607. Potentiometer R625 serves for d.c. balancing of the amplifier stage. The latter is controlled by EXT TRIG switch SK21. If this switch is depressed, current source TS607 causes a 10 mA current to flow through transistors TS604 and TS608 which can then transmit the signals to the trigger amplifier.

The trigger signals from channels A and B are symmetrically applied to similar circuits. For channel A the circuit comprises transistors TS611 and TS613 as gates and transistor TS612 as a current source. The current source is switched in by means of TRIG A switch SK21.
For channel B the gates are transistors TS614 and TS617, the current source being TS616. The current source is switched in by means of TRIG B switch SK21. Both input A and input B are provided with a pre-set potentiometer to adjust the balance of the stage: R636 for channel A and R656 for channel B.

The fourth possible trigger source is the MAINS. The trigger signal is transmitted to the trigger unit via a photo coupler in the power supply and applied 'common mode' to transistors TS623 and TS626. This 'common mode' drive suppresses fast interference signals and high frequencies in the trigger signal. Transistors TS623 and 626 are the gates and transistor TS624 is the current source. The current source is switched in by means of TRIG MAINS switch SK21.
Depending on which push-button of the horizontal deflection controls SK2 is depressed, one of the previously discussed signals is used for either triggering or horizontal deflection. When push-button DEL'D TB or MAIN TB SK2 is depressed, the signal is used for triggering. If, on the other hand, push-button EXT X DEFL SK2 is operated, the signal is fed to the horizontal amplifier on the switching unit. In that case, the signal is picked off from the collector of transistor TS609 which is then switched in, together with transistor TS602, via push-button EXT X DEFL SK2.

If push-button EXT X DEFL SK2 is released, the signal is fed to transistors TS603 and TS618. From these transistors, the signal is applied to that part of the trigger amplifier where the choice is made between h.f., l.f. and d.c. trigger coupling. The choice is made by means of trigger coupling controls SK19.

Push-button LF SK19 depressed: l.f. trigger coupling.
Current source TS628 is switched in. The cathodes of diodes GR603 and GR604 then carry a voltage of approximately +5 V.
Consequently, the signal from the trigger pre-amplifier cannot be transmitted via transistors TS627 and TS633. Instead it is transmitted via the signal path with R681 and R698, amplified by transistors TS629, TS632, TS639, TS637, TS641 and TS636 and applied to the bases of transistors TS642 and TS634. On these points, the trigger signal is integrated with the aid of capacitors C622 and C623 which are at one side connected to the +5 V voltage mentioned above.
Consequently, triggering on the l.f. component of the triggering signal is obtained.

Push-button HF SK19 depressed: h.f. trigger coupling.
Current source TS628 is switched off as push-button LF SK19 is released. Transistors TS629 and TS632 are turned off because their bases are earthed via double diode GR602 and push-button HF SK19. The triggering signal is applied to the bases of transistors TS642 and TS634, via transistors TS627 and TS633 and capacitors C622 and C623. Capacitors C622 and C623 now act as differentiators. Consequently, triggering on the h.f. component of the triggering signal is obtained.

Push-button DC SK19 depressed: d.c. trigger coupling. DC SK19 is a dummy switch which releases push-buttons LF and HF. In the DC position, LF SK19 and HF SK19 are open and, therefore, both the l.f. path and the h.f. path are in operation. Consequently, the entire triggering signal is transmitted. By means of potentiometer R712 in the emitter circuit of TS641 and TS636, the sensitivity of the l.f. path is equalized to that of the h.f. path. Therefore, the d.c. trigger signal will be undistorted.

The trigger level is set by means of LEVEL potentiometer R10 in the base circuit of transistor TS637. The control range of this potentiometer is preset with the aid of potentiometer R709 in the base circuit of transistor TS639.
Via transistors TS642 and TS634, the signal is applied to the push-pull amplifier with transistors TS643-TS646 and TS644-647.
The amplified triggering signal is applied to the trigger pulse shaper.

3.2.2.2. Trigger pulse shaper

The trigger pulse shaper is incorporated in circuit block IC601 (TRIGGER PULSE SHAPER). The input of this circuit block consists of four transistors, two of which are operating at the time. Which two transistors are operating depends on the position of the +/— trigger slope switch SK5, that enables triggering on either the positive- or the negative-going edge of the triggering signal.

The next circuit in the TRIGGER PULSE SHAPER block is the trigger multivibrator, which is switched over by the triggering signal. The resulting square-wave signal is differentiated and sharp trigger spikes are obtained. The negative-going spikes are available on output 16 of the TRIGGER PULSE SHAPER block and from there applied to the sweep-gating multivibrator of the main time-base generator.
The positive-going pulses are available on output 14 and they are used to control the automatic triggering circuit.
Potentiometer R737 which is connected to input 23 of the TRIGGER PULSE SHAPER block, is used to set the trigger slope balance.

3.2.2.3. Auto-circuit

The auto-circuit consists in principle of electrolytic capacitor C643 in parallel with the series circuit of transistors TS648 and TS649. When transistor TS649 receives positive-going trigger pulses from circuit block IC601 (TRIGGER PULSE SHAPER), this transistor starts conducting.
As a result of this, also transistor TS648 starts conducting and capacitor C643 is discharged. The output voltage of the auto-circuit is then approximately —15 V. This voltage is applied to the anode of diode GR803 in the main time-base sweep generator and sets the sweep-gating multivibrator input to such a level that it is driven by the negative-going trigger pulses.

If there are no trigger pulses available, capacitor C643 is no longer short-circuited. The sweep-gating multivibrator input is then set to such a level that initiation of the sweep depends only on the sweep feedback voltage: the main time-base sweep generator is free-running.

3.2.3. Main time-base generator

The main time-base generator comprises a sweep-gating multivibrator TS801-TS802, followed by switching transistors TS807 and TS808 which are in parallel with the time-base capacitors. Transistor TS806 is used as a current source to charge these capacitors. The sawtooth voltage across the time-base capacitors is taken off via transistor TS826 and the left-hand transistor of TS827. From here the sawtooth voltage is fed to the X deflection selector and fed back to the input of the sweep-gating multivibrator, via the hold-off circuit. Moreover, there is a circuit which indicates whether the main time-base generator is triggered or not.

The sawtooth voltage is generated by charging one of the time-base capacitors with a constant current to a certain level. The capacitor is then short-circuited and, therefore, discharged very quickly. The voltage across the capacitor is then shaped as a sawtooth.

3.2.3.1. Sweep-gating multivibrator

Sweep-gating multivibrator TS801-TS802 is controlled by the following signals: the negative-going trigger pulses supplied by the main trigger-pulse shaper, the voltage supplied by the hold-off multivibrator and the input bias voltage supplied by the auto-circuit. The trigger stability is preset with potentiometer R806.
Transistor TS805 is a current source to make the sweep-gating multivibrator insensitive for possible fluctuations in the supply voltage. The output square-wave of the sweep-gating multivibrator is applied to the switching transistors TS807 and TS808.

3.2.3.2. Switching transistors TS807 and TS808

Transistor TS808 is the switching transistor which is direct in parallel with the relevant time-base capacitor. As soon as this transistor receives a positive base voltage or current, it starts conducting and the time-base capacitor is discharged.
Transistor TS806 is the current source which provides a constant charging current for the time-base capacitors.
Transistor TS807, the other switching transistor, short-circuits the charging current to earth when the time-base capacitors are being discharged. Both switching transistors are driven with the same control signal, supplied by the sweep-gating multivibrator.

3.2.3.3. Sweep speeds

The sweep speed or time coefficient is determined by the capacitance of the time-base capacitor concerned and by the magnitude of the charging current.

The time-base capacitors are C805, C806, C807, C808 and C828.
Capacitors C806 and C828 are always in the circuit and the other capacitors are selected with the aid of transistors TS815, TS819 and TS821. These transistors are used as switches and work in two conditions only: hard on and hard off. A negative base voltage is used to turn the transistors off, to make sure that no collector current can flow. The transistors are turned on as soon as a positive voltage is applied to their base via the TIME/DIV switch SK14. The capacitor that is switched in by its appertaining transistor, is connected in parallel to capacitors C806 and C828.

The sweep speed is also selected by altering the magnitude of the constant charging current supplied by transistor TS806.
This current can be adjusted in steps by changing the emitter resistance of TS806 with the aid of TIME/DIV switch SK14. The charging current can be continuously controlled by changing the base drive of TS806 with the aid of TIME/DIV potentiometer R14. In the CAL position of the TIME/DIV potentiometer, switch SK15 is closed and the charging current is only determined by the calibrated emitter resistance.

To compensate for the temperature coefficient of the transistors (2 mV/^{o}C base-emitter junction), the base voltage of TS806 is supplied via transistor TS809. An extra advantage of this is a reduced load of the TIME/DIV potentiometer. Electrolytic capacitor C800 suppresses possible ripple and interference on the supply voltage.

Time-base capacitors C805, C806, C808 and C828 are precision capacitors. Capacitor C807 (4,7 μF), however, has a $\pm$ 10 % tolerance. This is compensated for by potentiometer R834 in the collector circuit of transistor TS811. With the aid of this potentiometer, the base voltage of TS809 is additionally controlled in those positions of the TIME/DIV switch where capacitor C807 is switched in. In positions where C807 is not switched in, diode GR802 is blocked and the additional control is inoperative.

3.2.3.4. Sawtooth take-off circuit

The sawtooth voltage that arises across the time-base capacitor is taken off via a Darlington circuit, comprising transistor TS826 and the left-hand transistor of TS827.
The emitter voltage of the left-hand TS827 transistor is applied to the X deflection selector, the comparator circuit and, via diode GR808, to the hold-off circuit of the main time-base generator.

3.2.3.5. Hold-off circuit

The purpose of the hold-off circuit is to prevent the sweep-gating multivibrator from responding to trigger pulses before the time-base capacitor has been completely discharged.

Via diode GR808, the sawtooth voltage is applied to the base of transistor TS824. The hold-off capacitors are part of the emitter circuit of this transistor. In every position of the TIME/DIV switch, a hold-off capacitor is switched in, in a similar way as the time-base capacitors.
Capacitor C812 is always in the circuit and the other capacitors, C809, C810 and C811, are switched in parallel to C812 by transistors TS820, TS821 and TS822, as dictated by the position of the TIME/DIV switch.

The selected hold-off capacitor is charged via transistor TS824 and discharged via TS825. Discharging in this case takes a considerably longer time than the discharging of the time-base capacitors. The bias of transistor TS825 can be varied by means of VAR. HOLD-OFF potentiometer R22 on the front panel, in order to manually vary the hold-off time.

The voltage across the selected hold-off capacitor drives Schmitt trigger TS816-TS817, the hold-off multivibrator. The output signal of the hold-off multivibrator is applied to the input of the sweep-gating multivibrator via emitter follower TS814. Emitter follower TS814 is there to isolate the trigger spikes supplied by the main trigger-pulse shaper from the hold-off multivibrator.

In the base circuit of transistor TS824 there is a switch SK9. This switch is closed when push-buttons AUTO and TRIG of the trigger-mode controls are depressed. If these buttons are released (push-button SINGLE depressed), switch SK9 is open. Then diode GR808 stops conducting and the hold-off multivibrator TS816-TS817 is no longer reset by the sweep voltage. The hold-off multivibrator is now reset via transistor TS818, by pressing SINGLE push-button SK9C.

The time-base generator must be switched off when it is not used to provide the X deflection voltage. This is obtained by depressing EXT X DEFL push-button SK2B of the horizontal-deflection controls, in the base circuit of transistor TS818. The hold-off multivibrator is then kept in such a state that its output voltage prevents the sweep-gating multivibrator from responding to trigger-pulses.

3.2.3.6. Indication lamp NOT TRIG'D

Indication lamp NOT TRIG'D is a light-emitting diode GR2 in the collector circuit of transistor TS812. This lamp serves two purposes.

In the first place it lights up when in the trigger modes AUTO and TRIG the time-base generator is not triggered. In that case, electrolytic capacitor C643 of the auto-circuit in the main trigger circuit is charged. As a result of this, the emitter voltage of transistor TS813 becomes less negative and the transistor turns off. Consequently, transistor TS812 starts conducting via resistor R838 and diode GR2 lights up. As soon as there are trigger pulses again, C643 is discharged, the emitter voltage of TS813 becomes more negative and the transistor starts conducting. Consequently, TS812 stops conducting and GR2 does not light up any longer.

In the second place the lamp is used as reset indicator in the SINGLE mode. If the SINGLE push-button has been pressed, the lamp lights up until the sweep is initiated by a trigger pulse. In this mode, transistor TS813 is driven on its base, the base drive depending on the state of hold-off multivibrator TS816-TS817.

3.2.3.7. Switching transistors TS803 and TS804

Transistors TS803 and 804 are part of the output circuit of the sweep-gating multivibrator. Transistor TS803 supplies pulses for the ALT supply of channels A and B to the channel selector logic, and reset pulses for the delayed time-base generator. Transistor TS804 provides blanking pulses that are applied to the Z amplifier, via the switching unit, in order to suppress the beam when the time-base generator is in the hold-off position.

3.2.3.8. D.C. Supply for the comparator circuit

The comparator, which will be discussed at a later stage, is used to start the delayed time-base generator at a certain time during the sweep of the main time-base generator. To this end, the sweep voltage of the main time-base generator is compared with an adjustable d.c. voltage. This d.c. voltage is controlled with DELAY TIME potentiometer R1 on the front panel. Potentiometer R1 receives its d.c. supply voltage via transistors TS829 and TS831. The set voltage is fed to the comparator via the right-hand transistor of TS827.
In the PM 3260 standard model, the beginning and the end of the multiplier scale can be calibrated with the aid of preset potentiometers R1513 and R1514.

3.2.4. Triggering of the delayed time-base generator

The delayed trigger circuit is a stripped version of the main trigger circuit. Therefore, please refer to section 3.2.2. **Triggering of the main time-base generator** for a description of the various circuits.

3.2.5. Delayed time-base generator

The delayed time-base generator is basically equal to the main time-base generator and, therefore, we shall only discuss the differences. For a description of the rest of the circuitry, please refer to section 3.2.3. **Main time-base generator.**

3.2.5.1. Sweep speeds

The circuitry is similar to that of the main time-base generator, but the constant current source for the time-base capacitors is provided with an extra preset potentiometer R1227. This potentiometer enables the sweep speeds of the delayed time-base generator to be equalized to those of the main time-base generator.

3.2.5.2. Hold-off circuit

Via diode GR1204 and emitter-follower TS1224, the sawtooth voltage is applied to hold-off multivibrator TS1218-TS1219.
The output voltage of the hold-off multivibrator brings the sweep-gating multivibrator in the hold-off position via emitter follower TS1217. The sweep-gating multivibrator is reset with the aid of reset multivibrator TS1222-TS1223.
The base of TS1223 is driven by the output signal of the sweep-gating multivibrator in the main time-base generator and by the output signal of the comparator. The reset multivibrator is switched over by the combination of these signals.

As a result of this, the hold-off multivibrator is reset via emitter follower TS1221 and, thus, the sweep-gating multivibrator TS1201-TS1202. If push-button STARTS SK8 has been depressed, the next sweep is then initiated.
If, however, TRIG push-button SK8 has been depressed, the sweep-gating multivibrator is switched over by a trigger pulse on the base of transistor TS1201. In position OFF of TIME/DIV switch SK12, the sweep-gating multivibrator is kept in such a state that it responds to neither trigger pulses nor reset pulses of the hold-off multivibrator.

3.2.5.3. Comparator

The comparator comprises the transistors TS1226 and TS1227. Transistor TS1226 is a double transistor in long-tailed pair circuit, TS1227 being a current source for this circuit. The d.c. voltage set by DELAY TIME potentiometer R1 is fed to the base of the right-hand transistor of TS1226, via R1282. The sawtooth voltage of the main time-base generator is fed to the left-hand transistor of TS1226, via R1281. As soon as the amplitude of the sawtooth exceeds the set d.c. voltage, the collector voltage of the left-hand transistor of TS1226 drops. This voltage drop is, together with the output signal of the sweep-gating multivibrator of the time-base generator, fed to the reset multivibrator TS1222-TS1223 as described in the previous section.

3.2.6. Switching unit or X deflection selector

The switching unit comprises the following circuits:
– A selector for the X deflection source.
– A switching circuit of the blanking pulses for the c.r.t.
– An X pre-amplifier for external X deflection signals.
– An X intermediate amplifier.

3.2.6.1. Selector for X deflection source

This circuit allows choice from X deflection by the main time-base signal, the delayed time-base signal or the signal from an external source. The deflection source is selected with the aid of X deflection controls SK2 MAIN TB, DEL'D TB, EXT X DEFL.

Push-button MAIN TB SK2 depressed: transistor TS1407 starts conducting. As a result of this, diodes GR1401 and GR1402 start conducting and the output signal of the main time-base generator is fed to the intermediate X amplifier. The conductance of transistor TS1407 also has as a consequence that transistors TS1408 and TS1409 are turned off. As a result of this, diodes GR1403-GR1404 and GR1406-GR1407 are blocked and signals from the delayed time-base or external X deflection signals are not transmitted.
Depressing MAIN TB push-button SK2 also results in conductance of transistor TS1404. Conductance of TS1404 causes transistor TS1406 to turn off and resistor R1422, the load of the main time-base generator, is out of the circuit, being replaced by R1423. The load of the main time-base generator remains, therefore, the same in all positions of the X deflection controls.

Depressing push-button EXT X DEFL SK2 and DEL'D TB SK2 has an analogous effect. The load of the delayed time-base generator also remains the same in all positions of the X deflection controls, as load resistor R1421 is replaced by R1424 when push-button DEL'D TB is depressed.

3.2.6.2. Switching circuit for blanking pulses

The switching circuit for blanking pulses comprises transistors TS1419 ... TS1426. The collectors of TS1422 and TS1424 have been connected to resistor R507, the input of the Z amplifier.
The current injected into the Z amplifier by these transistors is 0 mA for unblanking of the trace and 3 mA for the complete blanking of the trace.

The emitters of transistors TS1419 and TS1423 are, via load resistors R1474 and R1489, connected to respectively resistor R819 in the main time-base generator and resistor R1219 in the delayed time-base generator. During the sweep, 3 mA flows into the main time-base generator and during the hold-off period 0 mA. If the delayed time-base TIME/DIV switch occupies the OFF position, 3 mA flows into the delayed time-base generator.
These currents are supplied via resistors R1473 and R1491.
The collector currents of TS1419 and TS1423 are 5 mA during the hold-off period and 2 mA during the sweep. Of these collector currents, 2 mA flows to the −15 V supply via resistors R1479 and R1492. This results in a current for trace unblanking of 2−2 = 0 mA and a current for trace blanking of 5−2 = 3 mA.

Assume that the main time-base generator is switched in, i.e. MAIN TB switch SK2 closed. Then transistor TS1421 is blocked and the current step from 0 to 3 mA is applied to the Z amplifier, via transistor TS1422. If MAIN TB SK2 is open, i.e. the main time-base generator is not switched in, transistor TS1421 is conducting and the full current step from 0 to 3 mA is short-circuited via this transistor.
The input current of the Z amplifier is then 0 and the Z amplifier gives bright-up information.

Assume that only the delayed time-base generator is switched in, i.e. DEL'D TB SK2 closed. Then transistor TS1426 is blocked and the 0 to 3 mA bright-up information is fed to the Z amplifier, via transistor TS1424. If push-button EXT X DEFL SK2B is depressed, transistor TS1424 is blocked with as a result that the blanking information of the delayed time-base generator is not transmitted to the Z amplifier. The current step of the main time-base generator is short-circuited by the conducting transistor TS1421. The Z amplifier, therefore, receives no input current and the trace is unblanked.

The last possibility is mains time-base intensified by delayed time-base. During the part of the sweep where only the main time-base is running and not yet the delayed time-base, there flows no current to the Z amplifier via transistor TS1422, meaning unblanking of the trace.
However, the Z amplifier receives a 3 mA current from the delayed time-base via transistor TS1424. Thus, the trace is blanked as the nett input current of the Z amplifier is 3 mA. As soon as the delayed time-base starts and the intensified part begins, the current through transistor TS1424 is 0 and the Z amplifier brights up the trace. At the end of the delayed sweep, the current through TS1424 becomes 3 mA again and the trace is blanked. This would means that only the intensified portion of the trace is visible. However, it is possible to drain off part of the 3 mA through TS1424 via transistor TS1426 which is in parallel with the former. Depending on the position of INTENS potentiometer R20, a certain part of the current supplied by transistor TS1423 is drained off by TS1426.
This means that the dark level in the main time-base intensified by delayed time-base mode can be controlled via TS1426.
During the intensified portion, 0 mA flows to the Z amplifier which means complete unblanking of the trace. The intensity of the trace, however, can be controlled by INTENS potentiometer R20 which also acts upon the cathode current of the c.r.t. This control operates in such a way that the intensity relation between the normal and intensified part of the trace always remains the same. The ratio between both intensities can be set by means of potentiometer R1498.

3.2.6.3. X Pre-amplifier for external X deflection signals

The X pre-amplifier comprises transistors TS1400 ... TS1403.
The input signal of this circuit is applied to the emitter of transistor TS1400, via resistor R1404. The input signal may be one of the signals which can also be used for triggering, viz. the voltage on EXT input socket BU8, the channel A signal, the channel B signal or a mains-derived signal (also refer to section 3.2.2.1.).

If push-button EXT X DEFL of the horizontal deflection controls is depressed, the collector signal of transistor TS609 in the main trigger circuit is fed to R1404. The signal is amplified by transistors TS1400 and TS1402 and then applied to diode GR1406 in the X deflection selector. The base bias of transistor TS1400 is adjustable by means of pre-set potentiometer R1401. This potentiometer is used to balance the amplifier in such a way that rotating continuous X AMPL control R22 does not result in a trace shift on the screen.
The amplifier gain can be controlled by X AMPL potentiometer R22 in the gate circuit of field-effect transistor TS1403, the latter being used as a variable resistor.
The gain is preset with potentiometer R1419.

Transistor TS1401 is a constant current source, being the collector load of transistor TS1402.

3.2.6.4. Intermediate X amplifier

The intermediate X amplifier comprises transistors TS1412 to TS1418. The asymmetrical output signal of the X deflection selector (anodes of GR1402, 1404 and 1407) is applied to the base of transistors TS1412 and TS1413. An anti-phase signal is generated by means of transistors TS1417 and TS1418, resulting in a symmetrical signal being fed to the X output amplifier. The base bias of transistors TS1417 and TS1418 can be varied with X POSITION potentiometer R2. Variation of the bias causes the balance of the push-pull amplifier to be disturbed, which results in a horizontal trace shift on the screen.

The amplifier offers the possibility of using either the nominal gain (x1 position of TB MAGN switch SK3), or the gain increased by a factor of 10 (x10 position of the TB MAGN switch).

In the x1 position of TB MAGN switch SK3, current source TS1416 in the emitter circuits of transistors TS1413 and TS1418 is switched in.

Then these transistors are operative, but not transistors TS1412 and TS1417 because their current source TS1414 is turned off. The gain of this stage can be set by means of potentiometer R1462.

In the x10 position of TB MAGN switch SK3, TS1414 starts conducting. Consequently, transistor TS1416 turns off.
Transistors TS1412 and TS1417 are switched in and the amplifier stage with TS1413 and TS1418 is inoperative. The gain of amplifier stage TS1412-TS1417 is ten times higher than that of the previously discussed stage, and can be set by means of potentiometer R1444. Light-emitting diode GR1 indicates the 10x TB MAGN condition. The x10 amplifier is also inoperative when the EXT X DEFL push-button is depressed (SK2B open).

The outputs of both amplifier stages are connected to the final X amplifier by means of coaxial cables.

3.2.7. Final X amplifier

The final X amplifier consists of two amplifier stages in parallel (one for each deflection plate). In the following we shall describe one half.

The actual amplifier is the cascode circuit with transistors TS1702 and TS1703. Resistors R1704 and R1707 are feedback resistors. The cascode amplifier is controlled via the transistor TS1704 in common-base configuration. Resistor R1712 is the termination for the coaxial cable between the intermediate X amplifier. Current source TS1701 supplies the bias current for the amplifier.
The average voltage on the deflection plate is kept at +26 V by means of Zener diode GR1702. Capacitor C1701 improves the h.f. response and trimmer C1703 allows phase compensation in the feedback path of the cascode circuit.

3.2.8. C.r.t. circuits

3.2.8.1. Z Amplifier

Input signals are fed to the Z amplifier via resistors R506 and R507. The blanking pulses of the time base are fed to R506 and those of the chopper to R507. Transistor TS504 in common base configuration feeds the current pulses (see also section 3.2.6.2.) to the actual amplifier TS508-TS509.
The brilliance of the trace is controlled by means of INTENS potentiometer R20. Depending on the position of this potentiometer a smaller or larger part of the input current is drained off via transistor TS503. The larger the current drain, the more brilliant the trace.

The blanking signal is amplified in the stage with transistors TS508 and TS509, and taken off via emitter follower TS507.
Diode GR506 in the collector circuit of transistor TS504 clamps the dark level of the blanking current to the amplifier to 3 mA. Trimmers C509 and C525 allows optimum adjustment of the frequency response.

From the output of emitter follower TS507, the a.c. and d.c. components of the blanking signal are guided along different paths. The a.c. path runs straight to the Wehnelt cylinder of the c.r.t. via capacitor C522.

A d.c. signal is fed to the emitter of transistor TS512, via low-pass filter R534/C511 and resistor R532. Transistor TS512 constitutes a multivibrator together with transistor TS511.
The a.c. voltage on the collector of TS512 has a peak-to-peak value which depends on the voltage fed to the emitter of TS511 by the Z amplifier. The frequency of the multivibrator signal is approximately 30 kHz.

The following part of the d.c. path is encapsulated in compound as a protection from humidity and to keep the physical dimensions of the circuit as small as possible. The encapsulation contains a peak detector to rectify the a.c. voltage supplied by multivibrator TS511-TS512. Furthermore, there is a circuit for the bias voltages of the cathode and the Wehnelt cylinder of the c.r.t., and a supply circuit for the voltage on focussing anode g3.

The reason for the a.c. and d.c. paths is isolation of the cathode and Wehnelt cylinder, which are on a −2 kV potential, from the other circuits. The a.c. component of the blanking signal is transmitted straight away to the high-voltage part, via blocking capacitor C522 which is a high-voltage capacitor. The d.c. signal, however, is converted into an a.c. voltage and then transmitted to the high-voltage part, via capacitor C521, after which it is rectified.
The dark level can be adjusted with the aid of potentiometer R547 in the emitter circuit of transistor TS512 in the d.c. amplifier.

3.2.8.2. Focusing circuit

The electron beam is focussed with the aid of FOCUS potentiometer R21 which controls the emitter voltage of transistor TS514.
This transistor constitutes, together with transistor TS513, a multivibrator identical to the one with transistors TS511 and TS512. Across the collector resistor of TS514, R555, a signal arises whose amplitude depends on the position of FOCUS potentiometer R21. This signal is rectified in the encapsulated circuit which comprises, to this end, a double peak detector. The rectified voltage, approx. 200 V, is applied to focusing anode g3 of the c.r.t.

The emitter voltage of transistor TS514 does not only depend on the position of the FOCUS potentiometer, but is also determined by the position of INTENSITY potentiometer R20.
The signal from this potentiometer is applied to the emitter of TS514, via transistor TS516. In this way a kind of compensation is obtained: the focus of the electron beam is automatically adapted when the brilliance of the trace is varied. The necessity of readjusting the FOCUS control after rotating the INTENS potentiometer is, thus, largely obviated.

3.2.8.3. E.H.T. Converter

The converter circuit supplies a voltage of −2 kV for the cathode and the Wehnelt cylinder of the c.r.t., and a voltage of +18 kV for post-acceleration anode g9. The main components of the converter are oscillator TS2004 and transformer T2001. Across the secondary winding of transformer T2001, an a.c. voltage of periodically + and −2 kV arises.
This voltage is rectified by diode GR2001 and fed to the previously mentioned encapsulated circuit. The voltage on the anode of diode GR2001 is −2170 V. The secondary voltage of transformer T2001 is also rectified and multiplied by a factor of 9 in an encapsulated multiplier circuit, in order to obtain the required +18 kV. The converter frequency is 25 to 30 kHz.

The output voltage of the converter is kept constant by means of a regulator circuit. This circuit comprises transistors TS2001 and TS2003. The 2 kV voltage on the cathode of the c.r.t. is fed back to the base of transistor TS2003, via resistor R573 in the encapsulated circuit. If this voltage drops, the base current of transistor TS2003 increases, as its base voltage is also connected to the +45 V voltage via resistors R2002 and R2003. An increasing base current of transistor TS2003 causes the current through transistor TS2001 to increase. As a result of this, the base current of transistor TS2004 grows and the generated voltage increases. The regulation operates in an analoguous way, but in reverse direction, when the 2 kV voltage rises.

The 2 kV voltage is also protected against short circuits (the 18 kV voltage is protected by its high internal resistance).
If the current drain from GR2001 becomes too high, diode GR2003 turns off. Under normal conditions, this diode is always conducting. This means that normally the cathode is approximately 0,7 V negative with respect to earth. In case of overload or short-circuit of the 2kV voltage, this 0,7 V is cancelled out or may even become positive, depending on the magnitude of the short-circuit current. This causes the base voltage of transistor TS2002 to go positive and this transistor starts conducting. As a result of this, the current through transistor TS2003 decreases, causing a reduction of the current through transistor TS2001. Consequently, the base current of transistor TS2004 decreases and the converter switches off.
To avoid too high a load of the lower supply (section 3.2.9.) during switching on, the 2 kV oscillator is switched on after a delay of 0,3 s caused by capacitor C2000.

3.2.9. Power supply (Use a scope with differential inputs!)

The circuitry of the power supply has been designed in such a way, that the instrument can be connected to any mains voltage between 90 V and 264 V, without the necessity of adaptation to the local mains voltage.
The various output voltages of the power supply unit are stabilized.
The circuit is provided with a current limitation for overload protection.

3.2.9.1. Mains unit

The mains voltage is applied to the mains filter, via POWER switch SK22 and fuse VL1. The mains filter consists of two double coils L1801 and L1802, and capacitors C1801, C1802 and C1803. Between this filter and the rectifier bridge, there is a second filter consisting of coil L1800 and capacitor C1804. Both filters are used to suppress interference from the mains to the instrument and from the instrument to the mains.

The rectifier bridge comprises two series diodes in each branche. The ripple which results after rectifying the a.c. voltage is smoothed in the circuit with L1806 and capacitors C1806 and C1807.

3.2.9.2. Switching series regulator

In principle, the switching series regulator consists of switching transistor TS1801 with choke L1804, smoothing capacitor C1809, and diode GR1811. The base of transistor TS1801 is driven by a square-wave signal which periodically turns this transistor on and off. The on-off ratio can be varied and is determined by the regulator circuit.
The circuit operates as follows. When transistor TS1801 is conducting, capacitor C1809 is charged and the magnetic field in L1804 is built up. When TS1801 is cut off, L1804 is "discharged" via GR1811.

This is repeated with a frequency equal to the chopper frequency (refer to section 3.2.9.3.). To facilitate the starting of the circuit, a minute base current is fed to transistor TS1801, via resistor R1818 and diode GR1807.
When transistor TS1801 is cut off, its base is slightly negative due to the diode and parallel capacitor in the base circuit.

3.2.9.3. Chopper

The chopper circuit is formed by transistors TS1803 and diode GR1813 which, together with the base drive transformer T1801, from a push-pull oscillator.

The primary windings of the converter transformer T1802 provide the collector loads for the chopper transistors. Winding 7-8 supplies the feedback winding of the driver transformer. As the driver transformer saturates easily, a square-wave signal is generated.

As soon as the instrument is connected to the supply the small base current applied to TS1801 via resistors R1804, R1803 and R1817, transformer L1804, resistor R1825 and the parallel circuit of diode GR1810 and resistor R1848, causes the transistor to turn on.
Capacitor C1809 is thus charged by the collector current as described, and its voltage rises.

After some time the voltage on GR1813 will be 75 V and the voltage on trigger device GR1809 approx. 32 Volt (the "fire voltage"). Now GR1809 will trigger and has a "breakback voltage" of about 6 Volt. This causes a voltage rise on capacitor C1812. The voltage on capacitor C1812 becomes so high that one of the transistors TS1803 becomes conductive and the chopper starts. As soon as the chopper starts, the voltage across capacitor C1809 drops until transistor TS1801 conducts, controlled by the regulator circuit and the potential across capacitor C1809 rises again.

During oscillation, a negative voltage is developed on the centre tap of the driver transformer T1801, with respect to the emitter potentials of transistors TS1803. This negative potential on the base circuit prevents the conduction of both transistors TS1803, due to hole-storage capacitance. The frequency of the chopper is approximately 17 kHz.
Resistor R1814 in series with capacitor C1809 also prevents parasitic ringing of the circuit.

3.2.9.4. Regulator circuit

The output voltage of the chopper is regulated, after comparing the voltage across winding 7-8 of transformer T1802 with a reference voltage. The main component parts of the regulator circuit are transistor TS1806, potentiometer R1828 and integrated circuit IC1801. IC1801 comprises a reference voltage source and an operational amplifier.

The regulator circuit operates as follows. Across winding 7-8 of transformer TS1802 there is a square-wave voltage of 20 $V_{p\text{-}p}$. This voltage is rectified and results in a voltage of approximately −9 V plus a ripple voltage of approximately 0,2 $V_{p\text{-}p}$ across capacitor C1817. This ripple voltage is essential for the working of the regulator circuit.
Non-inverting input 3 of IC1801 has been connected to the wiper of potentiometer R1828. This potentiometer has been connected in parallel to capacitor C1817, via resistors R1827 and R1829 and diode GR1823. Diode GR1823 conducts via resistor R1831. Capacitor C1816 is fitted between the positive electrode of capacitor C1817 and the wiper of potentiometer R1828, in order to smooth the ripple voltage across C1817.

Consequently, the voltage on input 3 of IC1801 is a d.c. voltage. Inverting input 2 of IC1801 has been connected to point 4 of the integrated circuit, by means of resistor R1826. Within IC1801, there is a reference-voltage source between points 4 and 5. This circuit receives its supply voltage via point 8 of the integrated circuit.
The reference voltage between points 4 and 5 is approximately −7 V. The voltage on input 2 of the IC is approximately −2 V plus the 0,2 $V_{p\text{-}p}$ ripple voltage which is taken off from the negative side of capacitor C1817, via capacitor C1814. On output 6 of the IC there is a square-wave voltage, due to the large gain of IC1801. The on/off ratio of this voltage depends on the voltage between inputs 2 and 3 of the IC. The square-wave voltage on output 6 is applied to the base of transistor TS1806. The collector signal of TS1806 is used to drive transistor TS1801 of the switching series regulator.

Assume that for some reason the voltage across capacitor C1817 increases. The voltage on input 2 of IC1801 then goes more negative. The voltage on input 3 goes more negative too, but not as much as the voltage on input 2, because of the action of potentiometer R1828. In other words: the voltage on input 3 will be positive with respect to the voltage on input 2 of the IC. As a result of this, the output voltage on point 6 of the IC goes more positive; in terms of on/off ratio: the square-wave voltage will be 'on' during a longer time. This signal is inverted by transistor TS1806, with as a result that transistor TS1801 is blocked during a longer time. Consequently, the output voltage of the switching series regulator decreases.

There is also a foreward control, which means that IC1801 is also controlled by the mains voltage. To this end, input 3 of the IC has been connected to the rectified mains voltage, via resistor R1806. If the mains voltage increases, input 3 of IC1801 goes more positive with respect to input 2, with the same result as described in the previous section.

3.2.9.5. Current limiter

The current supplied by the power unit, also flows through resistor R1802 and the voltage drop across this resistor controls transistor TS1811. If the supply current becomes too high, transistor TS1811 starts conducting. As a result of this, pnpn transistor TS1808 ignites and causes a negative voltage on the base of transistor TS1807. This transistor is cut off and there will be a positive voltage on the base of transistor TS1806. Now switching series regulator transistor TS1801 is cut off. Because transistor TS1801 is blocked, the chopper stops operating. However, a minute base current is fed to transistor TS1801, via resistors R1803, R1804 and R1817. As a result of this, electrolytic capacitor C1809 is slowly charged. At a certain moment the chopper starts again and is immediately switched off again if the short-circuit or overload still exists. This oscillation is repeated approximately once every three seconds (depending on the mains voltage) and the supply is switched off again as long as the short-circuit persists. The current limitation is made independent of the temperature by means of n.t.c. resistor R1815.

3.2.9.6. Secondary supply voltages

The supply voltages for the various circuits in the instrument are obtained by rectifying and smoothing the secondary voltages of transformer T1802.
The filament of the c.r.t. is supplied with the rectified voltage of winding 17-18.

3.2.9.7. Mains coupler for triggering

The trigger source for mains triggering is isolated from the mains by means of opto-isolator. This is in fact a Light Emitting Diode and a Photo Transistor in one encapsulation: TS1809. Through the LED of TS1809 there flows the a.c. mains current. Independent of the mains voltage, 110 Volt or 220 Volt, there will be a fixed d.c. voltage at the emitter of TS1812. In the next three RC-stages, this d.c. voltage is integrated and coupled out by emitter follower TS1813. The output sine-wave voltage is taken off across resistor R1844.

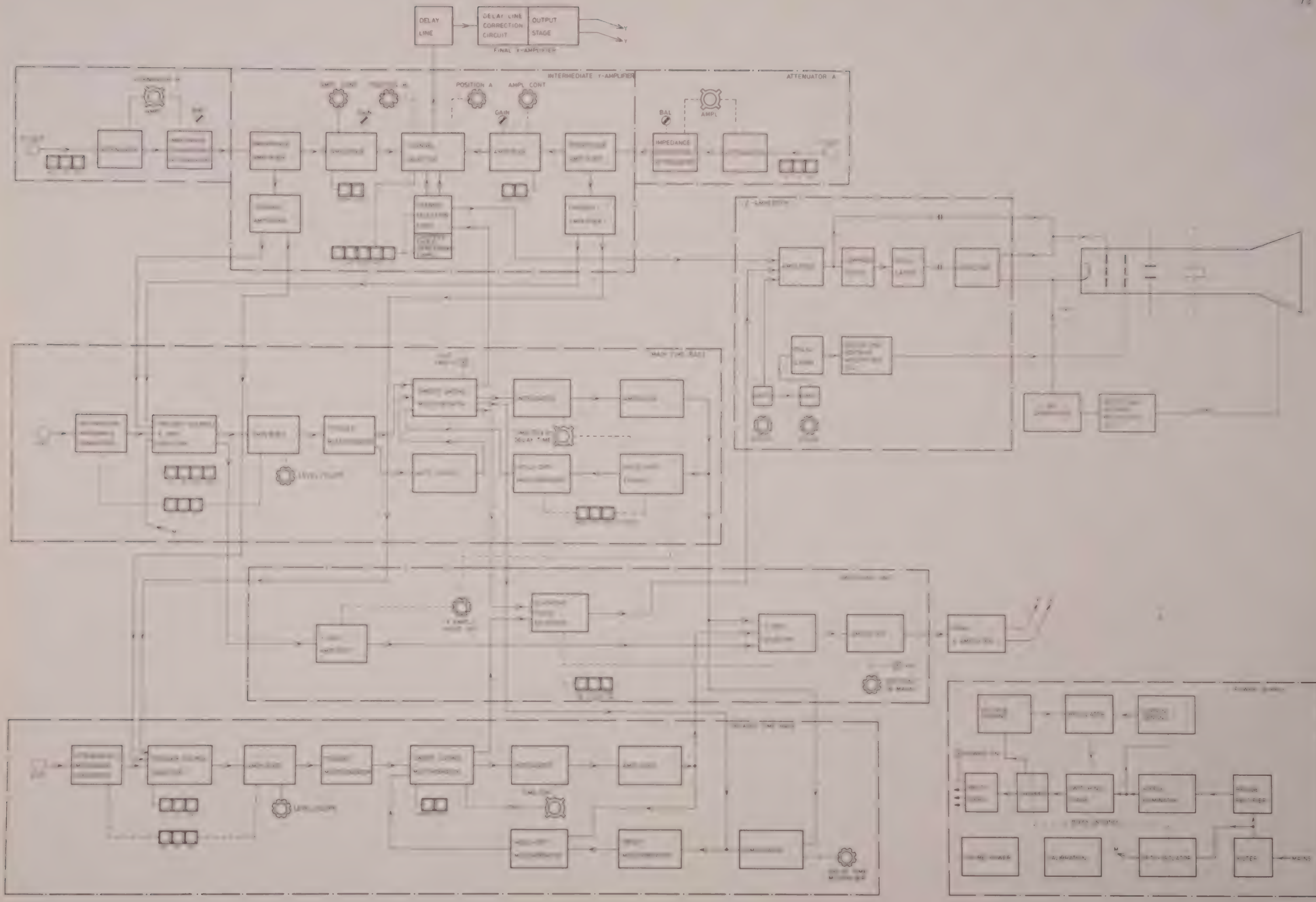
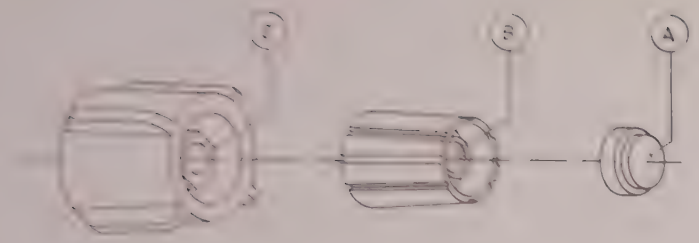
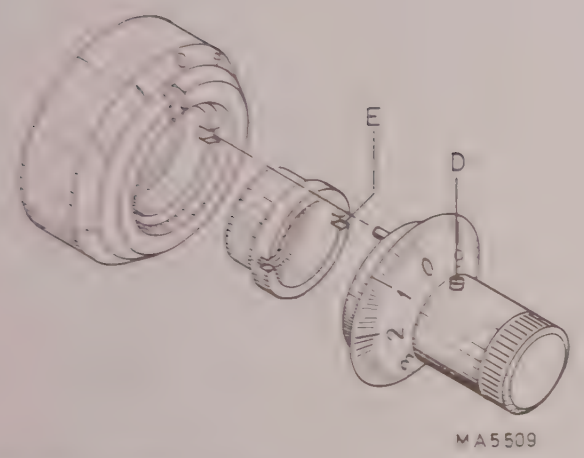


Fig. 3.1. Block diagram





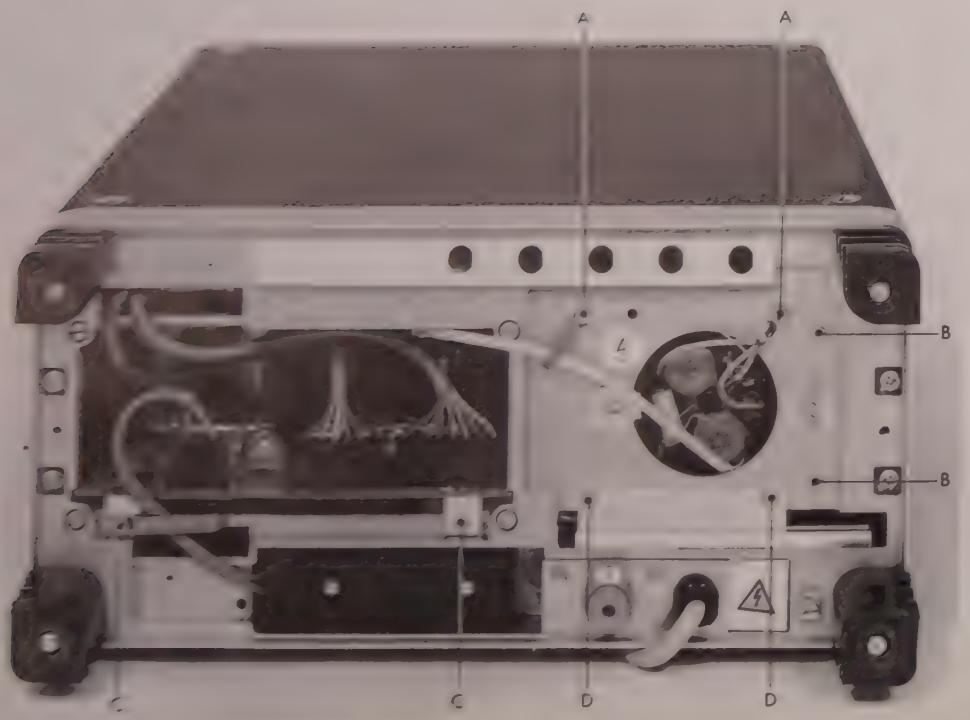


Fig. 3.4. Rear view with dismantling references

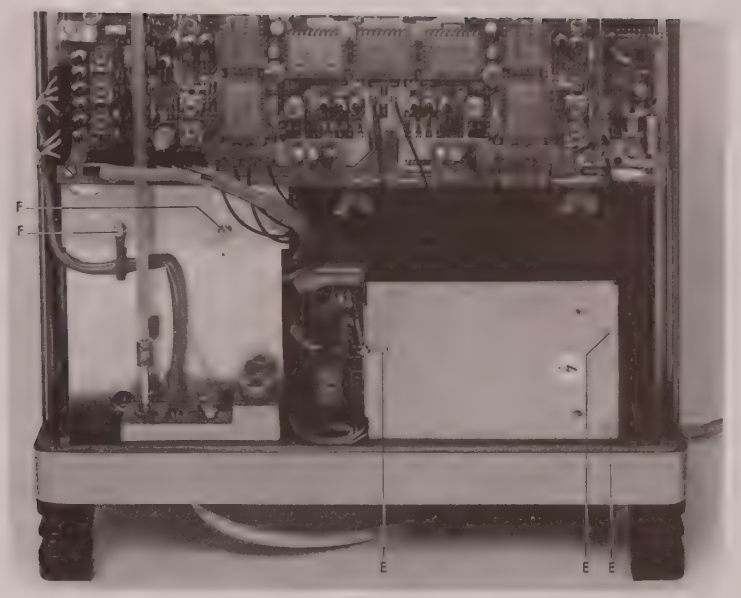


Fig. 3.5. Bottom view with dismantling references

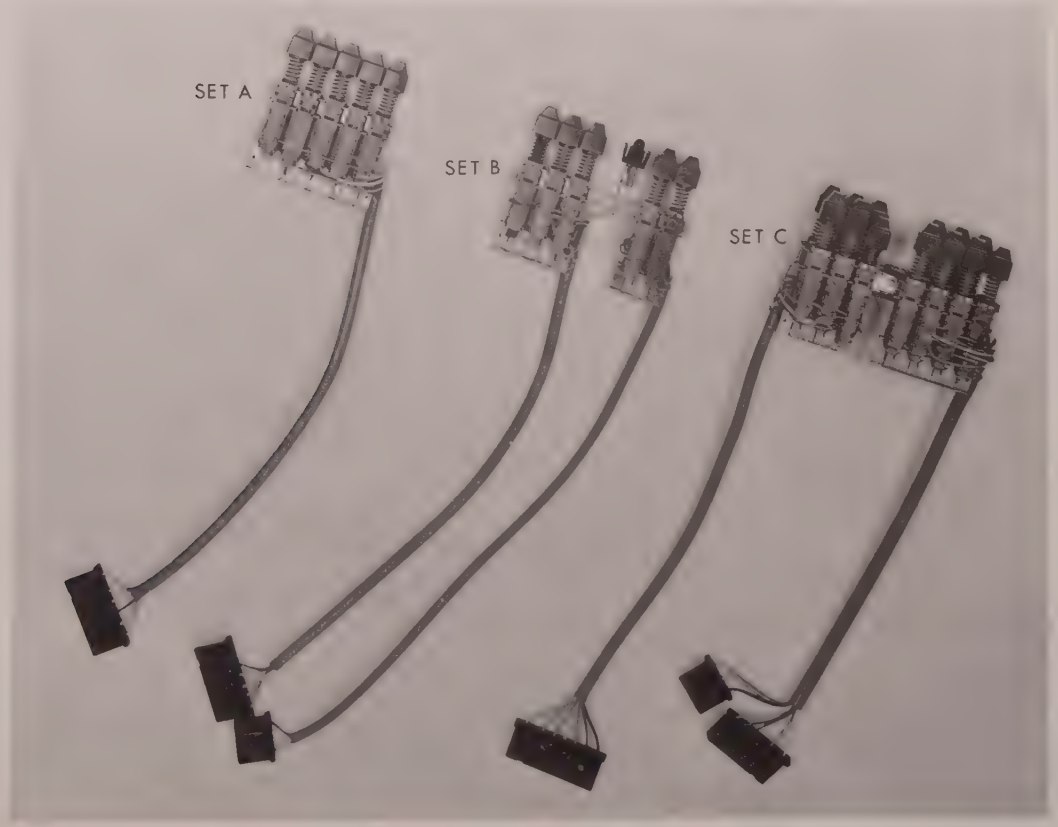


Fig. 3.6. Push-button sets

3.3.5. Removing the circuit board of the final X amplifier

- Remove the rear plate of the instrument (two screws)
- Remove the two screws A that secure the supports to the rear panel (Fig. 3.4.)
- Disconnect the miniature coaxial plugs and the single-wire connectors
- Unplug the four multipole connectors and disconnect the two wires from the c.r.t. pins
- Remove the circuit board from the oscilloscope

3.3.6. Removing the circuit board of the final Y amplifier

- Remove the rear plate of the instrument (2 screws)
- Slacken both screws of the final X amplifier
- Remove the two screws B which secure the supports to the rear panel (Fig. 3.4.).
- Disconnect the miniature coaxial plugs
- Unplug the multipole connectors and disconnect the two wires from the c.r.t. pins
- Remove the c.r.t. filter connections (2 soldering connections and 2 single-wire connectors on the soldering side of the board) and carefully lift out the circuit board

3.3.7. Removing the circuit board of the power supply (Fig. 3.4.)

- Remove the rear plate of the instrument (2 screws)
- Remove the screws C which secure the circuit board to the rear panel
- Unplug the three multipole connectors and disconnect the two single-wire connectors
- Disconnect the three wires of the mains filter
- Carefully withdraw the circuit board from its compartment

3.3.8. Removing the E.H.T. circuit board

- Remove the metal housing (three screws E in Fig. 3.5.)
- Unplug the multipole connectors
- Disconnect the E.H.T. connector after unscrewing the swivel nut and discharge the cable
- Unscrew the three hexagonal spacers and remove the circuit board
- Before screwing the E.H.T. cable on to a replacement board, the E.H.T. connector should be greased with Silicon Dielectric Compound. Order no. 4822 390 20023).

3.3.9. Removing the attenuator unit

- Remove the appropriate V/cm knobs and the nut under these knobs
- Unplug the multipole connector and the miniature coaxial plug on the circuit board of the intermediate amplifier
- Disconnect the earthing wire
- Remove the two screws that secure the lower part of the attenuator unit to the front panel
- Carefully lift the attenuator unit out of the oscilloscope

3.3.10. Removing the delay line

- Remove the rear plate of the instrument (2 screws)
- Remove the screws D (Fig. 3.4.) that secure the delay line to the rear panel
- Remove the two screws F (Fig. 3.5.) and the four miniature coaxial connectors
- Withdraw the delay line from the rear of the oscilloscope

3.3.11. Removing the focus unit

- Remove the circuit board of the X output amplifier in accordance with section 3.3.5.
- Remove the metal housing of the E.H.T. unit (3 screws E in Fig. 3.5.) and unplug the multipole connector of the focus unit
- Unsolder the three wires on the c.r.t. base (white, blue and yellow)
- Remove the focus unit by pressing the longer edges together

3.3.12. Removing the cathode-ray tube

ATTENTION: Be very careful with the side connections of the c.r.t. If these pins are bent, the c.r.t. is likely to develop a gas leak.

- Remove the delay line in accordance with section 3.3.10.
- Slacken the brace round the c.r.t. neck and remove the connections between c.r.t. and Y output amplifier.
- Remove the tube base
- Unplug the multipole connector of the orthogonality and trace-rotation coils on the intermediate amplifier
- Remove the metal housing of the E.H.T. unit and disconnect the E.H.T. cable (discharge the cable)
- Slacken the upper plastic centring bracket at the c.r.t. front
- Slacken the two screws that secure the mu-metal screening pipe to the rear chassis.
- Remove the bezel by pulling its lower edge
- Carefully withdraw the c.r.t. through the front panel of the instrument
- If the rubber sleeve around the neck of the c.r.t. must be slid over the neck of a replacement tube, the use of industrial talcum powder is strongly recommended.

3.3.13. Removing the push-button sets

Each of the push-button sets mentioned below is fitted to the front panel by means of two clamping devices:

The A/ALT/CHOP/ADD/B set (A in Fig. 3.6.)
The DEL'D TB/EXT X DEFL/MAIN TB set
The NORM/INVERT & NORM/INVERT set
The STARTS/TRIG & AUTO/TRIG/SINGLE set (B in Fig. 3.6.)
The DC/LF/HF & DC/LF/HF & A/B/EXT & A/B/EXT/MAINS set (C in Fig. 3.6.)

To remove a push-button set, the two recessed-head screws that secure the set to the front panel must be removed.
To replace one switch of a push-button set, refer to Fig. 3.7.

Before a push-button set is refitted, it is advisable to stick the two parts of the clamping device together by means of adhesive tape or non-hardening glue, in order to facilitate the replacement.

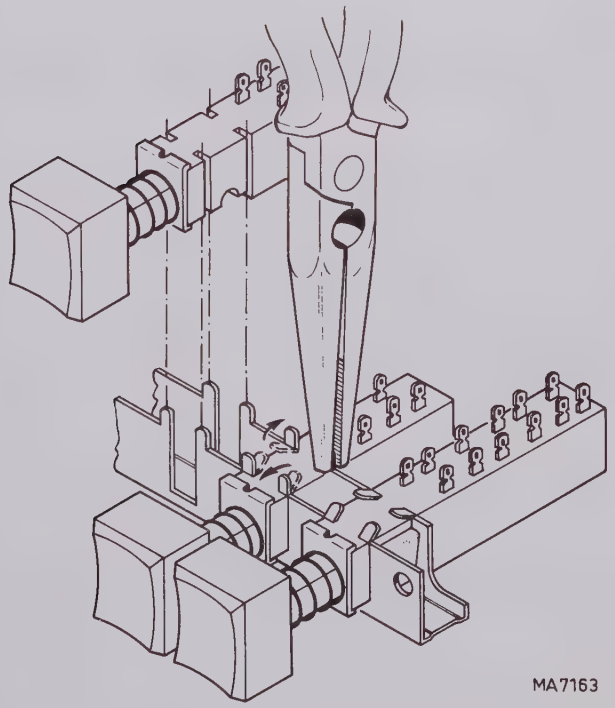


Fig. 3.7. Replacing a switch of a push-button set

3.3.14. Removing the carrying handle

1. Remove the upper and lower cabinet plates
2. Remove the plastic strip which is snapped on to the grip
3. Remove the four screws which secure the grip to the brackets
4. Depress the push-buttons in the brackets and turn the carrying handle as far as possible to the upper side of the oscilloscope
5. Keep the push-button of the right-hand bracket depressed and pull the bracket from its bearing[1)]
6. Remove the grip from the remaining bracket
7. Depress the push-button of the left-hand bracket and turn the latter as far as possible to the lower side of the instrument
8. Keep the push-button depressed and pull the bracket from its bearing

If it is impossible to remove the left-hand bracket in this way, remove also its bearing in a similar way as described in footnote 1).

1) With some instruments it may be impossible to remove the handle in the described way. This is due to an extra securing plate in the right-hand bearing. In that case, DO NOT USE FORCE, but work in accordance with the following procedure which replaces points 3, 4 and 5.

   3. Remove the two screws which secure the grip to the right-hand bracket
   4. Remove the two hexagonal bolts which secure the right-hand bearing to the side strip
   5. Depress the push-button of the right-hand bracket and take the bearing from the bracket.

3.3.15. Special tools

ATTENTION: When you are soldering inside the instrument it is essential to use a low-voltage soldering iron, the tip of which must be earthed to the mass of the oscilloscope.

3.3.15.1. Soldering iron for semi-conductors in micro-miniature plastic encapsulations (SOT23)

Because of the small dimensions of these SOT23 semi-conductors and the lack of space between the components on the printed-wiring board, it is necessary to use a miniature soldering iron with a pin-point tip (max. dia 1 mm) to solder a SOT23 on to a printed-wiring board.

Work method:
– Unsolder pin A (Fig. 3.8.)

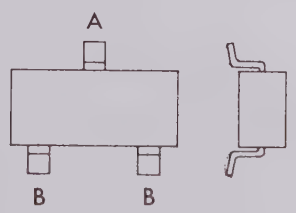


Fig. 3.8. SOT23 transistor

– Unsolder pins B and remove the SOT from the printed-wiring board
– Remove the superfluous solder and smooth down the soldering spots on the printed-wiring board. In this way, all three connection pins of the SOT are in contact with the printed conductors at the same time and damage to the SOT as a result of bending the pins, is prevented.
– Place the new SOT onto its soldering spot and keep it in place
– Solder the pins A and B to the printed-wiring board

NOTE: Bear in mind that the maximum permissible soldering time is 10 seconds during which the temperature of the pins must not exceed 250 °C. We, therefore, recommend the use of a solder with a low melting point, e.g. silver-containing solder (59 % tin, 34 % lead, 6 % silver, melting point 180 °C, order number 5322 390 84001).

Take care not damage the plastic encapsulation of the SOT during the soldering procedure (softening point of the plastic is 150 °C).

A suitable soldering-iron is e.g.
Low Voltage Mini Soldering Iron, Type 800/12 W - 6 V, power 12 W, voltage 6 V, order no. 4822 395 10004, in combination with 1-mm-pin-point tip, order no. 4822 395 10012.

3.3.15.2. Special tool for the slotted nut of attenuator switches A and B, order no. 5322 395 54023

For those who want to make such a tool, we give a sketch with the dimensions in mm in Fig. 3.9. The material is silversteel N094, tempered 40-45 Rc.

3.3.15.3. Special tool for the slotted nut of the POSITION and LEVEL/SLOPE potentiometers, order no. 5322 395 54024

For those who want to make such a tool, we give a sketch with the dimensions in mm in Fig. 3.10. The material is silversteel N094, tempered 40-45 Rc.

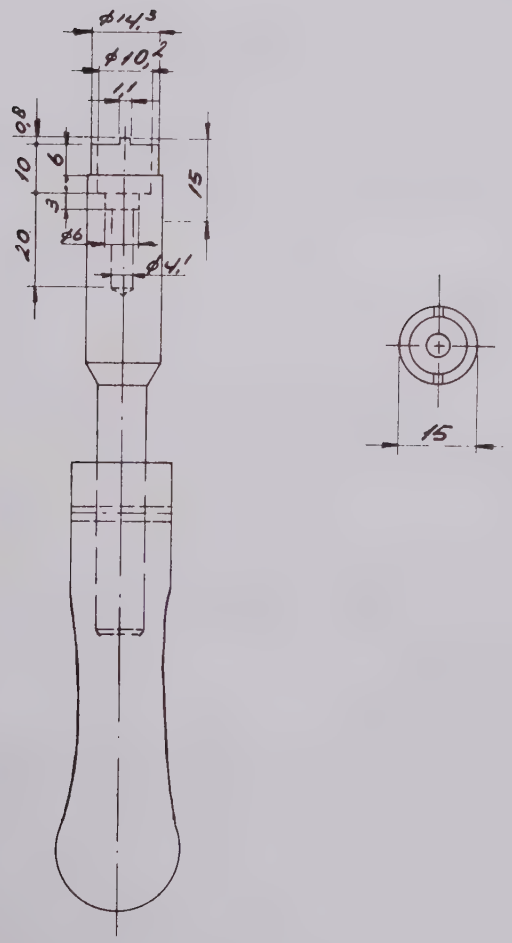


Fig. 3.9. Tool for attenuator unit

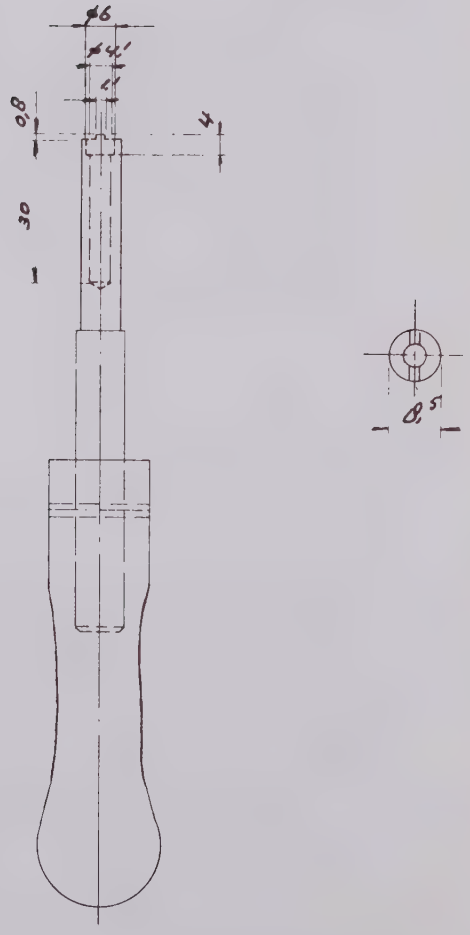


Fig. 3.10. Tool for positioning potentiometer

3.4. CHECKING AND ADJUSTING

The figures appertaining to the checking and adjusting procedure can be found at the end of section 3.4., pp. 104...108.

3.4.1. Performance check

3.4.1.1. Starting positions of the controls

- Connect the instrument to the mains
- Depress the ALT, MAIN TB and AUTO push-buttons
- Set the MAIN TIME/DIV switch to .1 ms
- Set the DEL'D TIME/DIV switch to OFF
- Set the AMPL switches to .1 V/DIV
- Set the TIME/DIV and AMPL potentiometers to CAL
- Set the TB MAGN switch to x1
- Set the POSITION potentiometers to their mid-positions
- Turn the INTENS and ILLUM potentiometers fully clockwise
- The controls not mentioned may occypy any position.
  Unless otherwise stated, the controls always occupy the same position as in the previous check.
- Set the POWER switch to ON
- Check that the POWER ON lamp lights up and that two time-base lines are displayed

3.4.1.2. C.r.t.

- Set the INTENS and FOCUS controls for a sharp, well-defined trace
- Centre both time-base lines, using the POSITION potentiometers
- Check that the traces run in parallel with the central horizontal graticule line; if necessary, readjust in accordance with section 3.4.2.4.4.

3.4.1.3. Vertical axes

D.C. Balance

- Depress the 0 button of the AC-0-DC switch
- Switch the AMPL step-attenuator between positions 5 mV/DIV and 10 mV/DIV
- Check that the trace does not jump more than 0,3 DIV. If necessary, readjust the BAL potentiometer on the front panel
- Repeat for the other channel

Trace height and pulse response

- Depress push-buttons A(B) of the display-mode controls, NORM of the signal-polarity controls and DC of the input-coupling switch
- Set the AMPL step attenuator to 10 mV/DIV
- Apply a square-wave signal with a rise time $\leqslant$ 1 ns, a peak-to-peak value of exactly 60 mV and a frequency of approx. 1 kHz to input socket A(B)
- Set the MAIN TB switch to a suitable position
- Obtain a stationary trace with the aid of the LEVEL potentiometer
- Check that the trace height is 6 DIV. If necessary, adjust the GAIN potentiometer on the front panel
- Check that the pulse top is straight within 3 % of the peak-to-peak value
- Increase the frequency of the input signal successively to 10 kHz, 100 kHz and 1 MHz
- Check that the pulse top remains straight within 3 % at these frequencies
- Set the MAIN TIME/DIV switch to 0.05 μs
- Pull the TB MAGN control to its x10 position
- Adjust the LEVEL control for a stable display
- Check that the rise time between 10 % and 90 % of the pulse height is $\leqslant$ 3 ns
- Push the TB MAGN control to its x1 position.
  If the pulse response of both channels does not meet the requirements stated above, readjust the vertical amplifiers in accordance with sections 3.4.2.5.3.

Bandwidth

- Connect a constant-amplitude sine-wave generator to input socket A(B)
- Set the generator to the reference frequency
- Adjust the output voltage of the generator to obtain a trace height of 8 DIV

– Increase the generator frequency until the trace height is 5,6 DIV
– Check that at this trace height the frequency exceeds 120 MHz

Common mode rejection

– Depress push-button ADD of the display-mode controls
– Depress the INVERT push-button of the channel B signal-polarity controls
– Set the AMPL switches to 5 mV/DIV
– Apply a sine-wave voltage simultaneously to sockets A and B
– Check the rejection in accordance with the following table

Note: Adjust the continuous AMPL control of channel A or channel B for minimum trace height

Input voltage	Generator frequency	Max. trace height	Rejection factor
120 mV	100 kHz	0,24 DIV	> 100
120 mV	2 MHz	0,24 DIV	> 100
120 mV	50 MHz	1,20 DIV	> 20

– Disconnect the input voltage

Chopped mode

– Depress push-button CHOP of the display-mode controls
– Set the MAIN TIME/DIV switch to 0,2 μs
– Check that there are two time base lines displayed which can be shifted with respect to one another, using the POSITION controls

Alternate mode

– Depress the ALT push-button of the display-mode controls
– Set the MAIN TIME/DIV switch to 10 μs
– Check that there are two time-base lines displayed which can be shifted with respect to one another, using the POSITION controls
– Set the MAIN TIME/DIV switch to 0,1 s
– Check that the channels are switched over after every sweep of the sawtooth voltage

3.4.1.4. Main time-base generator

Trigger slope, level and sensitivity

– Depress push-button A of the display-mode controls
– Set the channel A AMPL switch to .2 V/DIV
– Depress the AC push-button of the channel A signal-coupling controls
– Depress the DC push-button of the main time-base trigger coupling controls
– Apply a sine-wave signal with an amplitude of 1,6 V to input socket A, frequency approximately 30 kHz
– Set the MAIN TIME/DIV switch to such a position that a few cycles of the input sine wave are displayed.
– Push the SLOPE switch to its + position
– Check that the time-base generator starts on the positive-going part of the sine wave
– Pull the SLOPE switch to its – position
– Check that the time-base generator starts on the negative-going part of the sine wave
– Set the AMPL switch to position .1 V/DIV
– Position the trace in such a way that the bottom half of the signal is displayed
– Check that it is possible to shift the starting point of the sine wave over 8 DIV, by means of the LEVEL control
– Push the SLOPE switch to its + position
– Position the trace in such a way that the top half of the signal is displayed
– Check that it is possible to shift the starting point of the sine wave over 8 DIV, by means of the LEVEL control
– Reduce the input signal until the trace height is 0,5 DIV
– Check that the display remains triggered; if necessary readjust the setting of the LEVEL control.

Single-sweep operation

- Set the AMPL switch to .2 V/DIV
- Set the LEVEL control to mid-range
- Set the MAIN TIME/DIV switch to 0,1 s
- Depress push-button 0 of the channel A signal-coupling controls
- Push the SINGLE button of the trigger-mode controls
- Check that the NOT TRIG'D lamp lights up
- Depress push-button AC of the channel A signal-coupling controls
- Check that the trace is written once and that the NOT TRIG'D lamp is extinguished at the start of the sweep

Triggering on the mains frequency

- Depress the AUT button of the trigger-mode controls
- Depress the HF push-button of the trigger-coupling controls
- Set the MAIN TIME/DIV switch to 5 ms
- Apply a sine-wave signal at the mains frequency to input socket A
- Adjust the AMPL controls to obtain a trace height of 3 DIV
- There is no stable triggered display
- Depress push-button MAINS of the trigger-source controls
- Check that a stable display can be obtained by means of the LEVEL potentiometer

Time coefficients

- Set the AMPL switch to 0.1 V and the AMPL potentiometer to CAL
- Depress push-button DC of the trigger-coupling controls
- Set the MAIN TIME/DIV switch to 0.1 ms
- Depress push-button A of the trigger-source controls
- Apply a time-marker signal with a repetition time of 0,1 ms and an amplitude of approximately 600 mV to input socket A
- Check that the 8 centre periods have a total width of 8 DIV ± 2 % (in temperature range +20 °C ... +30 °C)
- Pull the TB MAGN switch to its x10 position
- Change the repetition time of the input signal to 10 µs
- Check that the 8 centre periods have a total width of 8 DIV ± 2 % (in temperature range +20 °C ... +30 °C)
- Push the TB MAGN switch to its x1 position
- Set the MAIN TIME/DIV switch to 10 ms
- Change the repetition time of the input signal to 10 ms
- Check that for the 8 centre pulses a display of one pulse per division is obtained
- Check all the other time-base positions in the same way

If the requirements stated above are not met, readjust the main time-base generator in accordance with section 3.4.2.7.1.

- Check that the control range of the MAIN TIME/DIV vernier control is 1 : 2,6 to 1 : 3,5

3.4.1.5. Delayed time-base generator

Trigger slope and level

- Depress push-button DEL'D TB of the horizontal-deflection controls
- Depress push-button A of the del'd tb trigger source controls
- Set the channel A AMPL switch to .2 V/DIV
- Depress the AC push-button of the channel A signal-coupling controls
- Depress the DC push-button of the delayed time-base trigger-coupling controls
- Depress push-button TRIG of the delayed time-base trigger-mode controls
- Set the MAIN TIME/DIV switch to 20 ms and the DEL'D TIME/DIV switch to 10 µs
- Apply a sine-wave signal with an amplitude of 1,6 V to input socket A, frequency approximately 30 kHz
- Push the SLOPE switch of the delayed time-base generator to its + position
- Check that the time-base generator starts on the positive-going part of the sine wave
- Pull the SLOPE switch of the delayed time-base generator to its – position
- Check that the time-base generator starts on the negative-going part of the sine-wave
- Set the AMPL switch to position .1 V/DIV

– Position the trace in such a way that the bottom half of the signal is displayed
– Check that it is possible to shift the starting point of the sine wave over 8 DIV, by means of the delayed time-base LEVEL control
– Position the trace in such a way that the top half of the signal is displayed
– Check that it is possible to shift the starting point of the sine wave over 8 DIV, by means of the delayed time-base LEVEL control

Time coefficients

– Turn the DELAY TIME control fully anti-clockwise
– Set the MAIN TIME/DIV switch to 0.2 ms and the DEL'D TIME/DIV switch to 0.1 ms
– Apply a time-marker signal with a repetition time of 0,1 ms and with an amplitude of approximately 600 mV to input socket A
– Check that the centre 8 periods have a total width of 8 DIV ± 2 % (in temperature range +20 °C ... +30 °C)
– Set the MAIN TIME/DIV switch to 20 ms and the DEL'D TIME/DIV switch to 10 ms
– Change the repetition time of the input signal to 10 ms
– Check that the centre 8 periods have a total width of 8 DIV ± 2 % (in temperature range +20 °C ... +30 °C)
– Check all the other time-base positions in the same way

If the requirements stated above are not met, readjust the del'd time-base generator in accordance with section 3.4.2.7.2.

– Check that the control range of the DEL'D TIME/DIV vernier control is 1 : 2,6 to 1 : 3,5

Delay time

– Depress push-button MAIN TB of the horizontal deflection controls
– Depress push-button STARTS of the trigger-mode controls
– Set the MAIN TIME/DIV switch to 0.1 ms and the DEL'D TIME/DIV switch to 0.05 μs
– Apply a time-marker signal with a repetition time of 0,1 ms to input socket A
– Adjust the LEVEL potentiometer of the main time-base generator for a stable, triggered display
– Check that the intensity modulation of the delayed time-base is visible over the entire control range of the INTENS potentiometer
– Check that the starting point of the delayed time-base (beginning of the intensified portion) can be continuously shifted in relation to the main time-base, by rotating the DELAY TIME control

The previous part of this section holds good for both PM 3260 and PM 3260E models. The following part, however, applies to the PM 3260 model only.

– Set the DELAY TIME control to 1.00
– Check that the start of the delayed time-base coincides with the start of the second time-marker pulse
– Set the DELAY TIME control to 9.00
– Check that the start of the delayed time-base coincides with the start of the tenth time-marker pulse.

If these requirements are not met, readjust the delay time in accordance with section 3.4.2.7.2.

Time jitter

– Depress push-button DC of the signal-coupling controls
– Depress push-button DEL'D TB of the horizontal-deflection controls
– Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to 1 μs
– Adjust the LEVEL potentiometer of the main time-base generator for a stable, triggered display
– Check that the time jitter does not exceed 0,3 DIV
– Depress push-button TRIG of the del'd tb trigger-mode controls
– Check that a jitter-free display can be obtained by adjusting the LEVEL control of the delayed time-base

3.4.1.6. X Deflection

D.C. Balance

– Depress push-button MAIN TB of the horizontal-deflection controls
– Set the X POSITION potentiometer to such a position that the starting point of the time-base line coincides with the left-hand vertical graticule line
– Depress push-button EXT X DEFL of the horizontal-deflection controls
– Check that the spot does not move more than 0,3 DIV when the X AMPL potentiometer is turned clockwise or anti-clockwise; if necessary, readjust in accordance with chapter 3.4.2.8.1.

X Deflection via channel A

– Depress push-button B of the display-mode controls
– Set the channel A AMPL switch to 0.5 V/DIV
– Apply a sine-wave signal of exactly 3 V_{p-p}, 2 kHz, to input socket A
– Check that the trace width is exactly 6 DIV
– Check that the control range of the X AMPL control is 1 : 3 to 1 : 4

X Deflection via channel B

– Depress push-button A of the display-mode controls
– Set the AMPL switch of channel B to 0.5 V/DIV
– Depress push-button AC of the channel B signal-coupling controls
– Depress push-button B of the X deflection selector
– Apply a sine-wave voltage of exactly 3 V_{p-p}, 2 kHz, to input socket B
– Check that the trace width is 6 DIV, ±0,5 DIV

External X deflection

– Depress push-button EXT of the X deflection selector
– Turn the X AMPL potentiometer fully clockwise
– Apply a sine-wave voltage of exactly 2,4 V_{p-p}, 2 kHz, to the EXT input socket
– Check that the trace width is 8 DIV, ±1,5 DIV

Bandwidth

– Depress push-button A of the X deflection selector
– Apply a sine-wave signal of exactly 4,5 V_{p-p}, 2 kHz, to input socket A
– Depress push-button B of the display-mode controls
– Check that the trace width is 9 DIV
– Increase the frequency of the input signal to 2 MHz
– Check that the trace width is at least 6,3 DIV

Phase difference

– Depress the CHOP push-button of the display-mode controls
– Depress push-buttons NORM of the signal-polarity controls
– Set the AMPL switches to 5 mV/DIV
– Depress the DC push-buttons of the signal-coupling controls
– Depress push-button B of the X deflection selector
– Apply a sine-wave voltage of 30 mV_{p-p}, 0,1 MHz, to both input socket A and input socket B
– Check that the phase difference does not exceed 3^{o}

X Deflection with internal voltage at mains frequency

– Depress push-button MAINS of the X deflection selector
– Set the mains voltage to 220 V
– Check that the trace width is 8 DIV, ±1,5 DIV; if necessary, readjust in accordance with section 3.4.2.8.3.

3.4.1.7. Calibration unit

– Check the CAL voltage for irregularities
– Check that the amplitude of the square-wave voltage is 3 V_{p-p}, ±0,7 %
– Check that the frequency is 2 kHz, ±2 %
– Check that the CAL current is 6 mA, ±1 %

If the requirements stated above are not met, readjust the calibration unit in accordance with section 3.4.2.10.

3.4.2. Adjusting procedure

3.4.2.1. General information

The following information provides the complete checking and adjusting procedure for the PM 3260 oscilloscope. As various control functions are interdependent, a certain order of adjustment is often necessary. The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment. Before any check or adjustment, the instrument must attain its normal operating temperature. Under average conditions this will be approximately 30 minutes after switching on.

All controls which are mentioned without item numbers are located on the front panel of the oscilloscope.

3.4.2.2. Recommended test equipment

Digital multimeter, e.g. PHILIPS type PM 2421 or PM 2422A.
Pulse generator, rise time ⩽ 200 ns, e.g. PHILIPS type PM 5711 or PM 5775/76.
Pulse generator, rise time ⩽ 1 ns, e.g. Tektronix type 106 or 284.
Constant amplitude signal generator, e.g. Tektronix type 067.0532.01.
R.C. Standardizer, 1 MOhm//15 pF, e.g. Tektronix type 067.0537.00.
Time-marker generator, e.g. Tektronix type 2901.
Oscilloscope with differential input facility e.g. PM 3210.

3.4.2.3. Preliminary control settings

- Depress push-buttons NORM of the polarity controls.
- Depress push-buttons DC of the signal-coupling controls.
- Set the DELAY TIME control to 0 (fully anti-clockwise).
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Push the TB MAGN control to position x1.
- Depress push-buttons START and AUTO of the trigger-mode controls.
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to OFF.
- Set the continuous TIME/DIV controls to CAL.
- Depress push-buttons DC of the trigger-coupling controls.
- Depress push-buttons A of the trigger-source controls.

3.4.2.3.1. If necessary, check the power supply voltages first, refer to 3.4.2.9.

3.4.2.4. Cathode-ray tube circuit

3.4.2.4.1. Focus and astigmatism

- Depress push-button A of the display-mode controls.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Apply a sine-wave signal at a frequency of 100 kHz to input A.
- Adjust the display height to 6 DIV, using the AMPL switch and vernier.
- Set the MAIN TIME/DIV switch and the LEVEL potentiometer to such a position that several complete cycles are displayed.
- Set the INTENS potentiometer for normal brilliance.
- Check that a reasonably sharp trace can be obtained with the aid of the FOCUS potentiometer. If necessary, readjust potentiometer R579 (ASTIGM.) on the H.T. converter board (Fig. 3.11).
- Increase the trace brilliance using the INTENS potentiometer.
- Check that still a sharp trace can be obtained with the aid of the FOCUS potentiometer.

3.4.2.4.2. Brilliance

- Depress push-button A of the display-mode controls.
- Depress push-button DEL'D TB of the horizontal-deflection controls.
- Turn the INTENS potentiometer clockwise.
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to 1 μs
- Depress push-button 0 of the signal-coupling controls.
- Check that a dot at the start of the trace is just visible.
  If necessary, readjust potentiometer R547 (INTENSITY) on the horizontal output-amplifier and Z amplifier circuit board (Fig. 3.12.).
- Set the MAIN TIME/DIV switch to 0.05 μs and the DEL'D TIME/DIV switch to OFF.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Pull the TB MAGN switch to x10.
- Set the INTENS potentiometer for normal brilliance.
- Check that the brilliance is uniform over the entire trace.
  If necessary, readjust trimmers C509 and C525 (BLANK. PULSE) located on the horizontal output-amplifier and Z-amplifier circuit board.

3.4.2.4.3. Brilliance ratio

- Depress push-button A of the display-mode controls.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Turn the DELAY TIME control to 5.0 (mid-position).
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to .2 ms.
- Depress push-button AC of the signal-coupling controls.
- Apply a sine-wave signal at a frequency of 100 kHz to input A.
- Set the display height to 6 DIV.
- Set the INTENS potentiometer to a position 90° from the anti-clockwise stop; see Fig. 3.13.
- Check that the trace of the main time-base generator is just visible over the entire screen and that the part determined by the delayed time-base generator is more brilliant. If necessary, readjust the INTENS RATIO potentiometer R1498 on the X deflection selection circuit board (Fig. 3.14.).

3.4.2.4.4. Trace rotation

- Depress push-button A of the display-mode controls.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Centre the time-base line, using the POSITION controls.
- Check that the time-base line runs exactly in parallel with the horizontal lines of the graticule; if necessary, readjust TRACE ROT potentiometer R589 on the intermediate amplifier circuit board (Fig. 3.15.).

3.4.2.4.5. Shift correction

- Depress push-button A of the display-mode controls.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Connect a d.c. voltmeter to the vertical-deflection plates (test points A in Fig. 3.12).
- Set the channel A POSITION potentiometer to obtain a voltage of 0 V (±300 mV) between the deflection plates.
- Check that the time-base line is displayed exactly in the centre of the screen; if necessary, readjust SHIFT CORR. potentiometer R588 on the intermediate-amplifier circuit board (Fig. 3.15).

3.4.2.4.6. Orthogonality

- Depress push-button ALT of the display-mode controls.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Depress push-button 0 of the channel A signal-coupling controls.
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TB switch to 5 μs.
- Set the channel B AMPL switch to 5 mV/DIV and its vernier control to CAL.
- Apply a sine-wave voltage of 120 mV, frequency 100 kHz, to input B.
- Centre the intensified part, using the DELAY TIME control.
- Centre the channel A time-base line, using the channel A POSITION potentiometer.
- Check that the angle between the horizontal and vertical line is 90° see Fig. 3.16. If necessary, readjust X-Y CORR potentiometer R587 on the intermediate-amplifier board (Fig. 3.15).
- Check also trace rotation (chapter 3.4.2.4.4.).

3.4.2.4.7. Geometry (= Barrel and pin cushion distortion)

- Depress push-button A of the display-mode controls.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Apply a sine-wave voltage at a frequency of approx. 100 kHz to input A.
- Set the AMPL controls to obtain a display height of 7,4 DIV.
- Apply a sine-wave voltage at a frequency of approx. 50 Hz to input B.
- Depress push-button EXT X DEFL of the horizontal-deflection controls.
- Depress push-button B of the main time-base trigger-source controls.
- Set the channel B AMPL switch and the X AMPL control to obtain a display width of 9,4 DIV.
- Check that the edges of the display lie within the hatched area shown in Fig. 3.17.; if necessary, readjust the GEOMETRY potentiometer R568 on the H.T. converter board (Fig. 3.11.).

3.4.2.5. Vertical deflection

3.4.2.5.1. Gain

- Depress push-button A (B) of the display-mode controls.
- Depress push-button NORM of the polarity controls.
- Set the AMPL switch to .5 V/DIV.
- Set the AMPL vernier control to CAL.
- Depress push-button DC of the signal-coupling controls.
- Apply a square-wave voltage with an amplitude of exactly 3 V to input A (B).
- Check that the display height is exactly 6 DIV. If necessary, check that the display height is more than 6,7 to 7 DIV with gain control completely clockwise.
  For gain control adjustments refer to chapter 3.4.2.5.3. and Fig. 3.20.
- Check that the control range of the AMPL vernier control is at least 1:2,5.

3.4.2.5.2. Balance

1. D.C. Balance

- Depress push-button A (B) of the display-mode controls.
- Centre the time-base line, using the POSITION control.
- Turn the AMPL switch between 20 mV/DIV and 5 mV/DIV.
- Check that the trace does not jump more than 0,3 DIV; if necessary, adjust the BAL control on the front panel.

2. Gain balance

Before adjusting the Gain Balance, first check D.C. Balance.

- Rotate the AMPL vernier control between maximum and minimum.
- Check that during this procedure the time-base line does not shift more than 0,3 DIV; if necessary, readjust potentiometer R220A (R220B) on the intermediate-amplifier board, Fig. 3.15 (Fig. 3.18).

3. Polarity balance

Before adjusting the Polarity Balance, the D.C. Balance and the Gain Balance must be adjusted in accordance with both previous sections.

- Check that the time-base line does not shift more than 0,3 DIV when push-button INVERT of the polarity controls is depressed; if necessary, readjust POL BAL potentiometer R383 (R333) on the intermediate-amplifier board, Fig. 3.15 (Fig. 3.18).

4. Zero adjustment, R361 (R311)

- Connect a d.c. voltmeter between the points 11 and 15 of IC354 (IC304).
- Check that the d.c. voltage is 0 V, if necessary, readjust with R361 (R311) on the intermediate amplifier board.

3.4.2.5.3. Frequency response (and gain) of vertical amplifiers

In the following section three stages are checked: the final Y-amplifier, the inetermediate amplifier and the attenuators.

1. 200 Hz, R132A(B) and R423

- Depress push-button NORM of the polarity controls
- Depress push-button DC of the signal-coupling controls
- Set the AMPL vernier control to CAL
- Set the AMPL switch to 10 mV/DIV
- Apply a square-wave voltage with a rise time $\leqslant$ 1 ns and a frequency of 200 Hz to input A(B)
- Set the amplitude of the input signal to obtain a trace height of 6 divisions.
- Check that the displayed pulse is straight; if necessary, readjust with R132A(B) on the attenuator board and R423 on the final Y ampl. board.

2. 2 kHz, C108A(B)

- Set the generator frequency to 2 kHz.
- Set the main-time base controls to obtain a suitable, triggered delay.
- Check that the top of the displayed pulse is straight; if necessary, readjust C108A(B) on the attenuator boards.

3. 30 kHz, R366, C369, R373 (R316, C319, R323) and C120A(B)

- Set the generator frequency to 30 kHz
- Set the main-time base controls to obtain a suitable, triggered display
- Check that the top of the displayed pulse is straight; if necessary, readjust with R366, C369-R373 on the intermediate amplifier board (R316, C319-R323) and eventually C120A(B) on the attenuator board.

4. 100 kHz, C372-C407-R408, R368-R409-R410-C122A-R363B (C322-R318-C122B-R363A)

- Set the generator frequency to 100 kHz
- Set the main-time base controls to obtain a suitable, triggered display.
- Check that the top of the displayed pulse is straight; if necessary readjust with C372-C407-R408, R368-R410-C122A and R363B (C322, C122B and R363A) on intermediate amplifier-, final amplifier- and attenuator board.

5. 1 MHz

- Set the generator frequency to 1 MHz
- Set the main-time base controls to obtain a suitable, triggered display
- Check that the displayed pulse is correct; if necessary, repeat and average the previous adjustments in such a way, that the displayed pulse at 1 MHz is also within its tolerance.

6. Attenuator

- Depress push-button A (B) of the display-mode controls.
- Depress push-button NORM of the polarity controls.
- Depress push-button DC of the signal-coupling controls.
- Apply a square-wave voltage with a rise time $\leqslant$ 200 ns and a frequency of 2 kHz to input A (B).

Frequency compensation

- Set the AMPL switch to the positions indicated in the following table, at the same time setting the input amplitude to the appertaining values.
- Check that there is an optimum display of the input signal; if necessary, readjust the relevant trimmer.

AMPL switch to	Signal at input A (B)	Adjust with (Fig. 3.15; Fig. 3.18)
10 mV/DIV	Already adjusted (C108) in intermediate amplifier adjustment; refer to 3.4.2.5.3.2.	
.1 V/DIV	600 mV	C101
1 V/DIV	6 V	C109

Input capacitance

- Apply the square-wave input voltage (rise time ⩽ 200 ns, frequency 20 kHz) to input A (B) via an RC Standardizer of 1 MOhm//15 pF.
- Set the AMPL switch to the positions indicated in the following table, at the same time setting the input amplitude to the appertaining values.
- Check that there is an optimum display of the input signal; if necessary, readjust the relevant trimmer.

AMPL switch to	Signal at input A (B)	Adjust with (Fig. 3.15; Fig. 3.18)
10 mV/DIV	60 mV	C107
.1 V/DIV	600 mV	C102
1 V/DIV	6 V	C111

3.4.2.5.4. Chopping

- Depress push-button CHOP of the display-mode controls.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Set the MAIN TIME/DIV switch to 0.2 μs.
- Check that there are two time-base lines displayed which can be shifted in relation to one another by means of the POSITION controls.
- Set the POSITION potentiometers to obtain a distance of 3 DIV between the two lines.
- Depress push-button EXT of the main time-base trigger-source controls.
- Apply the chopper signal (available at point 8 of IC1601 on the intermediate amplifier circuit board) to the EXT input of the main time-base. It is then possible to trigger the time-base generator with the chopper frequency.
- Set the LEVEL potentiometer for a triggered display.
- Check that the chopper frequency is approx. 1 MHz.
- Check that each signal is displayed for approx. 300 ns.
- Check that the trace is blanked during the channel-switching.
- Check that the blanking time is approx. 200 ns.

3.4.2.6. Triggering

When checking and adjusting the trigger amplifiers, bear in mind that the various trigger circuits are interdependent as shown in the block diagram.

3.4.2.6.1. Trigger amplifiers (channels A and B) on intermediate amplifier circuit board

1. Shift

- Depress push-button 0 of the channel A (B) signal-coupling controls.
- Measure the voltage between points C and D (A and B) see Fig. 3.15 (Fig. 3.18).
- Check that the voltage is 0 V ± 10 mV; if necessary, readjust SHIFT potentiometer R351 (R301).

2. Zero level

Before checking the zero level, the trigger amplifier must be checked in accordance with the previous section (p.1.).

- Depress push-button 0 of the channel A (B) signal-coupling controls.
- Measure the voltage between point D (B) and earth (Fig. 3.15; Fig. 3.18).
- Check that the measured voltage is 0 V ± 50 mV; if necessary, readjust ZERO level potentiometer R354 (R304).

3.4.2.6.2. Trigger amplifier of the main time-base

Before checking and adjusting the trigger amplifier of the main time-base, the trigger amplifiers of channels A and B must be checked in accordance with section 3.4.2.6.1.

1. Level

- Depress push-button MAIN TB of the horizontal-deflection controls.
- Depress push-buttons 0 of the signal-coupling controls.
- Depress push-button HF of the trigger-coupling controls.
- Connect test point C, Fig. 3.22 (base of TS637) to earth.
- Measure the voltage on point D, Fig. 3.22 (point 4 of IC601) with respect to earth.
- Check that the measured voltage is 9 to 10 V, and does not change when the SLOPE switch of the main time-base is set from + to −; maximum allowable deviation is 100 mV. If necessary, readjust LEVEL potentiometer R709 (Fig. 3.22).
- Depress push-button DC of the trigger-coupling controls.
- Depress push-button A (B) of the trigger-source controls.
- Check that the voltage on test point D of the main time-base board does not change when the SLOPE switch is set from + to −; maximum allowable deviation is 100 mV. If necessary, readjust YA (YB) potentiometer R636 (R656), Fig. 3.22.
- Depress push-button EXT of the trigger-source controls.
- Check that the voltage on test point D of the main time-base board does not change when the SLOPE switch is set from + to −; maximum allowable deviation is 100 mV. If necessary, readjust EXT potentiometer R631 (Fig. 3 22).
- Remove earth connection from testpoint C.

2. L.F. Gain

This control (R712) equalizes the gain of the lf- and hf path of the trigger amplifier circuit. In this procedure a signal is applied to the channel A input, while the signal in the trigger circuit is shown on channel B.

- Depress push-button B of the display-mode controls.
- Depress push-button NORM of the polarity controls.
- Depress push-button DC of the channel A signal-coupling controls.
- Depress push-button AC of the channel B signal-coupling controls.
- Depress push-button A of the trigger-source controls.
- Set the AMPL switch of channel A to 20 mV/DIV and the AMPL switch of channel B to 0.1 V/DIV.
- Apply a square-wave voltage of 120 mV, frequency 20 kHz, to input A.
- Apply the signal at test point A (TS634) or B (TS642) to channel B input.
- Set the LEVEL control on the front panel for maximum signal to channel B.
- Check that the top of the displayed pulse is straight; if necessary, readjust LF GAIN potentiometer R712 (Fig. 3.22).
- Depress push-button LF of the trigger-coupling controls.
- Check that the displayed pulse is shaped as shown in Fig. 3.23.
- Depress push-button HF of the trigger-coupling controls.
- Check that the displayed pulse is shaped as shown in Fig. 3.24.

3. Trigger sensitivity (gain)

- Depress push-button A of the display-mode controls.
- Set the AMPL switch to 20 mV/DIV.
- Depress push-button AC of the signal-coupling controls.
- Depress push-button DC of the trigger-coupling controls.
- Apply a sine-wave voltage of 120 mV (2 kHz) to input A.
- Check that the starting point of the displayed sine-wave does not move when the SLOPE switch is set from + to −; if necessary, readjust TRIG SENS potentiometer R737 on the main time-base board (Fig. 3.22).

3.4.2.6.3. Trigger amplifier of the delayed time-base

1. Level

- Depress push-button DEL'D TB of the horizontal-deflection controls.
- Depress push-buttons 0 of the signal-coupling controls.
- Depress push-buttons HF of the del'd tb trigger-coupling controls.
- Connect test point C', Fig. 3.22 (base of TS1037) to earth.
- Measure the voltage on point D', Fig. 322 (point 4 of IC1001) with respect to earth.
- Check that the measured voltage is 9 to 10 V and does not change when the SLOPE switch of the delayed time-base is set from + to −; maximum allowable deviation is 100 mV. If necessary, readjust LEVEL potentiometer R1109 (Fig. 3.22).
- Depress push-button DC of the trigger-coupling controls.
- Depress push-button A (B) of the trigger-source controls.
- Check that the voltage on test point D' of the delayed time-base board does not change when the SLOPE switch is set from + to −; maximum allowable deviation is 100 mV. If necessary, readjust YA (YB) potentiometer R1036 (R1056), Fig. 3.22.
- Depress push-button EXT of the trigger-source controls.
- Check that the voltage on test point D' does not change when the SLOPE switch is set from + to −; maximum allowable deviation is 100 mV. If necessary, readjust EXT potentiometer R1031 (Fig . 3.22).
- Remove earth connection from test point C'.

2. L.F. Gain

This control (R1112) equalizes gain of the lf- and hf path of the trigger amplifier circuit. In this procedure a signal is applied to the channel A input while the signal in the trigger circuit is shown on channel B.

- Depress push-button B of the display-mode controls.
- Depress push-button NORM of the polarity controls.
- Depress push-button DC of the channel A signal-coupling controls.
- Depress push-button AC of the channel B signal-coupling controls.
- Depress push-button A of the trigger-source controls of the delayed-time base.
- Set the AMPL switch of channel A to 20 mV/DIV and the AMPL switch of channel B to 0.1 V/DIV.
- Apply a square-wave voltage 120 mV, frequency 20 kHz, to input A.
- Apply the signal at testpoint A (TS1042) or B (TS1034) to the channel B input.
- Set LEVEL control on the front panel for maximum signal to channel B.
- Check that the top of the displayed pulse is straight; if necessary, readjust LF GAIN potentiometer R1112 (Fig. 3.22).
- Depress push-button LF of the trigger-coupling controls of the delayed time-base.
- Check that the displayed pulse is shaped as shown in Fig. 3.23.
- Depress push-button HF of the trigger-coupling controls.
- Check that the displayed pulse is shaped as shown in Fig. 3.24.

3. Trigger sensitivity (gain)

- Depress push-button A of the display-mode controls.
- Set the AMPL switch to 20 mV/DIV.
- Depress push-button AC of the signal-coupling controls.
- Depress push-button DC of the trigger-coupling controls of the delayed time-base.
- Depress push-button DEL'D TB of the horizontal-deflection controls.
- Depress push-button TRIG of the trigger-mode controls of the delayed time-base.
- Set the MAIN TIME/DIV switch to 20 μs and the DEL'D TIME/DIV switch to 10 μs.
- Apply a sine-wave voltage of 120 mV to input A.
- Check that the starting point of the displayed sine-wave does not move when the SLOPE switch is set from + to −; if necessary, readjust TRIG GAIN potentiometer R1137 on the delayed time-base board (Fig. 3.22).

3.4.2.7. Sweep circuits

3.4.2.7.1. Main time-base

1. Stability

- Depress both 0 push-buttons of the signal-coupling controls.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Depress push-button TRIG of the trigger-mode.
- Set the DEL'D TIME/DIV switch to OFF.
- Rotate the LEVEL control fully anti-clockwise.
- Turn STAB potentiometer R806 fully clockwise (Fig. 3.22).
- Rotate STAB potentiometer R806 approx. 20° past the point where the time-base line ceases to be displayed.
- Depress push-button AUTO of the trigger-mode and check if the sweep circuit is running.

2. Time coefficients

As the power supply may affect the sweep times, it must be checked when the sweep times are not correct.

- Connect a time-marker generator to a Y input socket.
- Depress push-button MAIN TB of the horizontal-deflection controls.
- Push the TB MAGN control to position x1.
- Set the MAIN TIME/DIV switch to 0.1 ms.
- Apply a time-marker signal of 0.1 ms.
- Check that the 8 centre cycles cover exactly 8 DIV; if necessary, readjust X1 potentiometer R1462 (Fig. 3.14).
- Pull the TB MAGN control to position x10.
- Set the time-marker generator to 10 μs.
- Check that the 8 centre cycles cover exactly 8 DIV; if necessary, readjust X10 potentiometer R1444 (Fig. 3.14.).
- Set the MAIN TIME/DIV switch to 10 ms.
- Push the TB MAGN control to position x1.
- Set the time-marker generator to 10 ms.
- Check that for the 8 centre cycles a display of one cycle per DIV is obtained; if necessary, readjust 10 ms potentiometer R834 (Fig. 3.22).
- Check the sweep times in all other positions of the MAIN TIME/DIV switch; tolerance ± 2 % in temperature range +20 °C to +30 °C.

3. Linearity

- Depress push-button MAIN TB of the horizontal-deflection controls.
- Pull the TB MAGN control to position x10.
- Depress push-button AUT of the trigger-mode controls.
- Set the MAIN TIME/DIV switch to 0,05 μs.
- Set the time-marker generator to 10 ns.
- Check that the 4 centre cycles cover exactly 8 DIV; if necessary, readjust trimmers C1703 and C1707 (Fig. 3.12.).

3.4.2.7.2. Delayed time-base

1. Stability

- Depress push-button 0 of the signal-coupling controls.
- Rotate the DELAY TIME control fully anti-clockwise.
- Depress push-button DEL'D TB of the horizontal-deflection controls.
- Depress push-button TRIG of the del'd tb trigger-mode controls.
- Depress push-button AUTO of the trigger-mode controls.
- Set the MAIN TIME/DIV switch to 0.2 ms and the DEL'D TIME/DIV switch to 0.1 ms.
- Rotate the del'd tb LEVEL control fully anti-clockwise.
- Rotate STAB potentiometer R1206 on the delayed time-base board fully anti-clockwise (Fig. 3.22).
- Rotate STAB potentiometer R1206 approx. 20° past the point where the time-base line ceases to be displayed.

2. Time coefficients

— Connect a time-marker generator to the channel A input.
— Rotate the DELAY TIME control fully anti-clockwise (delay time minimum).
— Depress push-button DEL'D TB of the horizontal-deflection controls.
— Depress push-button TRIG of the del'd tb trigger-mode controls.
— Depress push-button AUTO of the trigger-mode controls.
— Set the MAIN TIME/DIV switch to 0.2 ms and the DEL'D TIME/DIV switch to 0.1 ms.
— Depress push-button DC of the del'd tb trigger-coupling controls.
— Depress push-button A of the del'd tb trigger-source controls.
— Apply a time-marker signal of 0.1 ms.
— Check that the 8 centre cycles cover exactly 8 DIV; if necessary, readjust 0.1 ms potentiometer R1227 (Fig. 3.22).
— Set the MAIN TIME/DIV switch to 20 ms and the DEL'D TIME/DIV switch to 10 ms.
— Set the time-marker generator to 10 ms.
— Check that the 8 centre cycles cover exactly 8 DIV; if necessary, readjust 10 ms potentiometer R1234 (Fig. 3.22).
— Check the sweep times in all other positions of the DEL'D TIME/DIV switch; tolerance ±2 % in temperature range +20 °C to +30 °C. Keep during this check the DELAY TIME control fully anti-clockwise and the MAIN TIME/DIV switch one position slower than the DEL'D TIME/DIV switch. In this way, the delayed time-base can complete an entire sweep.

3. Delay-time

This procedure only applies to the standard model PM 3260 and not to the PM 3260E model.
— Depress push-button A of the display-mode controls.
— Depress push-button DC of the signal-coupling controls.
— Depress push-button MAIN TB of the horizontal-deflection controls.
— Depress push-buttons AUTO and STARTS of the trigger-mode controls.
— Set the MAIN TIME/DIV switch to 0.1 ms and the DEL'D TIME/DIV switch to 0.05 µs.
— Depress push-button DC of the trigger-coupling controls.
— Depress push-button A of the trigger-source controls.
— Apply a time-marker of 0,1 ms.
— Set the DELAY TIME control to 1.00.
— Check that the spot of the delayed time-base coincides with the starting point of the second time-marker pulse; if necessary, readjust START potentiometer R1514 on the switching-unit board (Fig. 3.14).
— Set the DELAY TIME control to 9.00.
— Check that the spot of the delayed time-base coincides with the starting point of the tenth time-marker pulse; if necessary, readjust STOP potentiometer R1513 on the switching-unit board (Fig. 3.14.).

As the START and STOP adjustments are slightly interdependent, they must be repeated until both conditions are fulfilled.

3.4.2.8. Horizontal deflection

3.4.2.8.1. Balance of the horizontal amplifier

If necessary, first check trigger amplifiers on the intermediate amplifier circuit board.

— Depress push-button MAIN TB of the horizontal-deflection controls.
— Push the TB MAGN control to X1.
— Set the X POSITION control to such a position, that the time-base line starts at the first vertical graticule line.
— Depress push-button EXT X DEFL of the horizontal-deflection controls.
— Depress push-button A of the X deflection-source controls.
— Check that the spot does not move more than 0.3 DIV when the X AMPL potentiometer is rotated clock-wise and anti-clockwise; if necessary, readjust POS potentiometer R1401 on the switching-unit board (Fig. 3.14).
— Check that after this adjustment the spot lies within one DIV from the screen centre.

3.4.2.8.2. X Deflection via channel A

- Depress push-button B of the display-mode controls (the vertical A channel is now blocked).
- Set the channel A AMPL switch to 0.5 V/DIV.
- Depress push-button AC of the signal-coupling controls.
- Depress push-button EXT X DEFL of the horizontal-deflection controls.
- Depress push-button A of the X deflection-source controls.
- Apply a sine-wave voltage of exactly 3 V_{p-p}, frequency 2 kHz to input A.
- Check that the trace length is exactly 6 DIV; if necessary, readjust GAIN potentiometer R1419 on the switching-unit board (Fig. 3.14).

3.4.2.8.3. X Deflection with the mains frequency

- Depress push-button EXT X DEFL of the horizontal-deflection controls.
- Depress push-button MAINS of the X deflection-source controls.
- Check that the trace width is 8 DIV ± 1,5 DIV; (mains voltage 220 V) if necessary, readjust potentiometer R669 on the main-time base circuit board, Fig. 3.22. (in instruments of the –/01 model, this potentiometer is located on the power supply circuit board, R1838, Fig. 3.25).

3.4.2.9. Power supply

Warning: Use an isolating mains transformer when working in the power supply unit.
Bear in mind that the main part of this unit is connected direct to the mains.
As it is preferred to check the proper function of the power supply with adjustable mains voltage, use of a variable transformer (insulated version) is recommended.

Attention: The power supply unit is provided with one pre-set potentiometer R1828 Fig. 3.25, which controls the d.c. output of the circuit. DO NOT READJUST THIS POTENTIOMETER UNLESS IT IS STRICTLY NECESSARY.
A consequence of readjusting this potentiometer is that all d.c. output voltages change, so that several circuits of the oscilloscope (e.g. time base sweep) must be recalibrated.
In the factory this potentiometer has been adjusted to the nominal value of the +15 V output (measured on point 6 of the 6-pole connector of the power supply).
This voltage must be +15 V + or –200 mV.

General

The best way to check the power supply is, when this unit is connected to the normal circuitry of the PM 3260. Provisions have been taken that the unit, after being taken out, remains connected to the instrument. To facilitate the removal, first disconnect the various connections of the power supply unit.
For locating a possible overload or short-circuit in the various units of the oscilloscope, the supply connectors of the units may be disconnected, one at the time. Also the supply currents can be measured on each contact of these connectors. To disconnect one contact of a connector carefully press (twice) the spring at the side of the contact and lift the contact out. Inserting an additional contact provided with a piece of extension wire simplifies current measurement. After replacing the original contact check the spring locking-action to prevent the contact from coming loose later-on.

When the power supply unit is overloaded, the current limitation is actuated. As a result of this, the power supply goes in the "hiccup" mode (3-seconds cycle time approx.). This is caused by, successively, slow charging of the capacitor C1809, starting of the chopper, activation of current limiting transistor TS1808, discharging of the regulator circuit capacitors and so on.
Another reason for the power supply going in the "hiccup" mode is, when the switching transistor TS1801 gets no base current from the regulator circuit. In this case capacitor C1809 is slowly charged until the chopper circuit starts which causes the discharge of this capacitor in a short time, and so on.

If necessary, the power supply unit only, can be checked with the aid of a dummy load, consisting of load resistors and capacitors and a 6 V pilot lamp; see Fig. 3.67.
If a fault is suspected in the power supply, the following procedure may help you to find what is wrong.

NOTE: The power supply must always be loaded with the nominal load.

3.4.2.10. Calibration unit

- Check the CAL square-wave for irregularities.
- Check that the amplitude is 3 V ± 0.7 %; if necessary, readjust CAL SP potentiometer R1906 Fig. 3.15 on the intermediate-amplifier board.
- Check that the frequency of the CAL voltage is 2 kHz ± 2 %.
- Check that the CAL current is 6 mA ± 1 %.

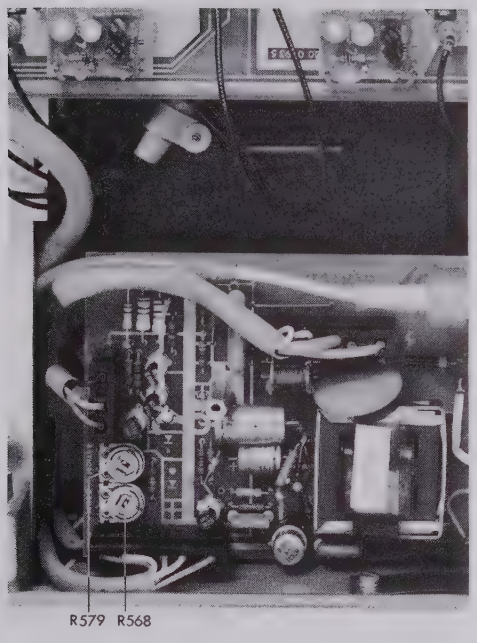


Fig. 3.11.
H.T. Converter board with adjusting references

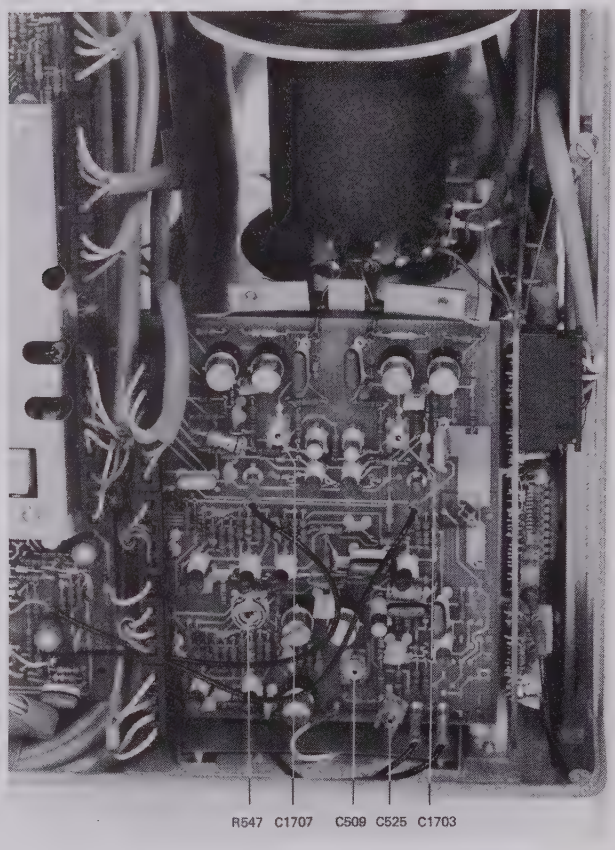


Fig. 3.12.
Final X and Z amplifier board with adjusting references

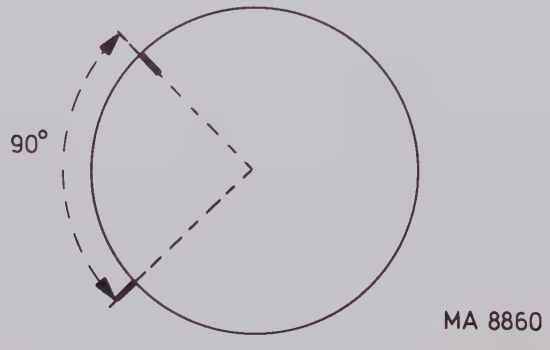


Fig. 3.13. Position of the INTENS potentiometer

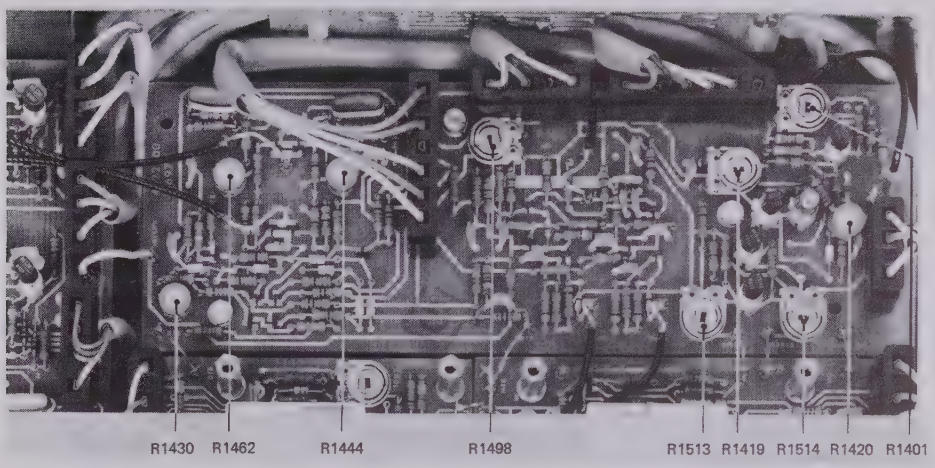


Fig. 3.14. Switching unit with adjusting references

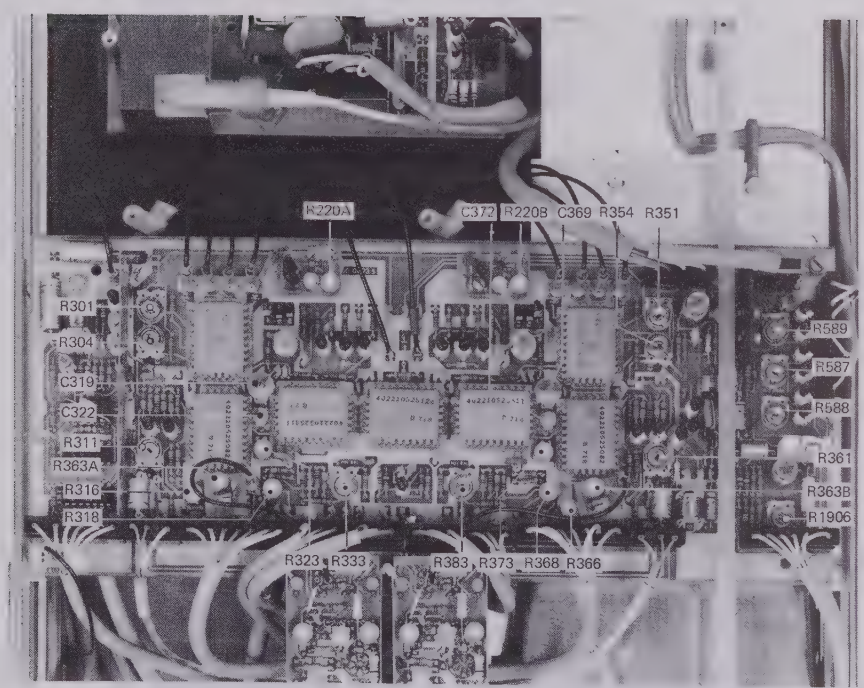


Fig. 3.15. Intermediate amplifier board with adjusting references

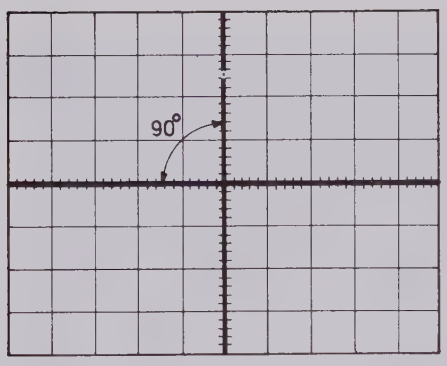


Fig. 3.16. Orthogonality check

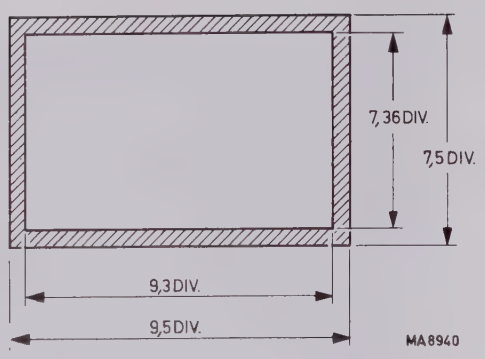


Fig. 3.17. Geometry check

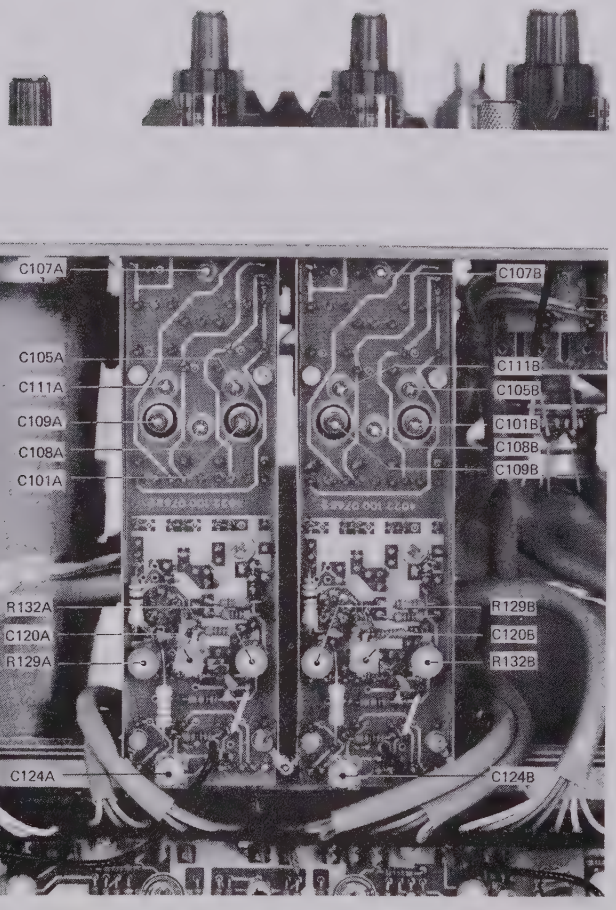


Fig. 3.18. Intermediate amplifier board with adjusting references

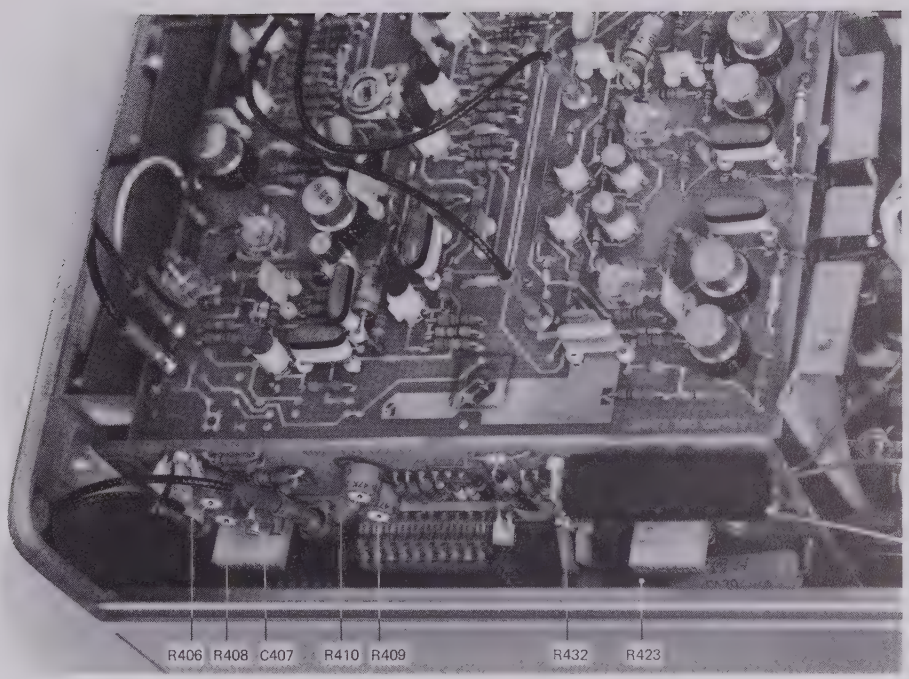


Fig. 3.19. Final Y amplifier with adjusting references

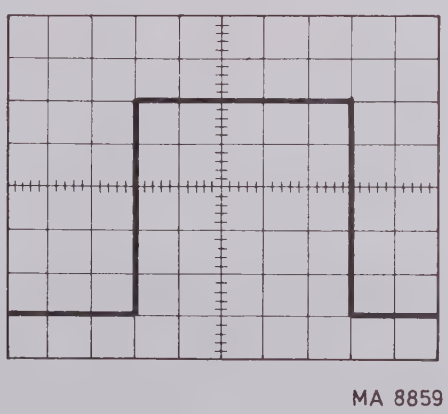


Fig. 3.20. Pulse response

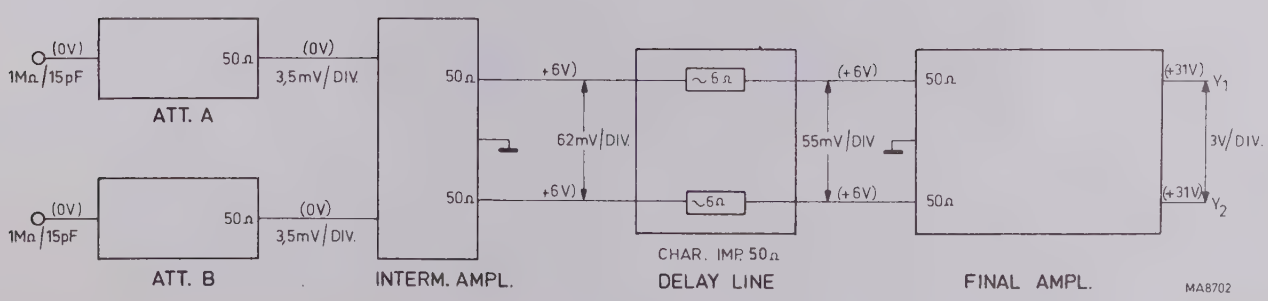


Fig. 3.21. Y Amplifier voltage levels

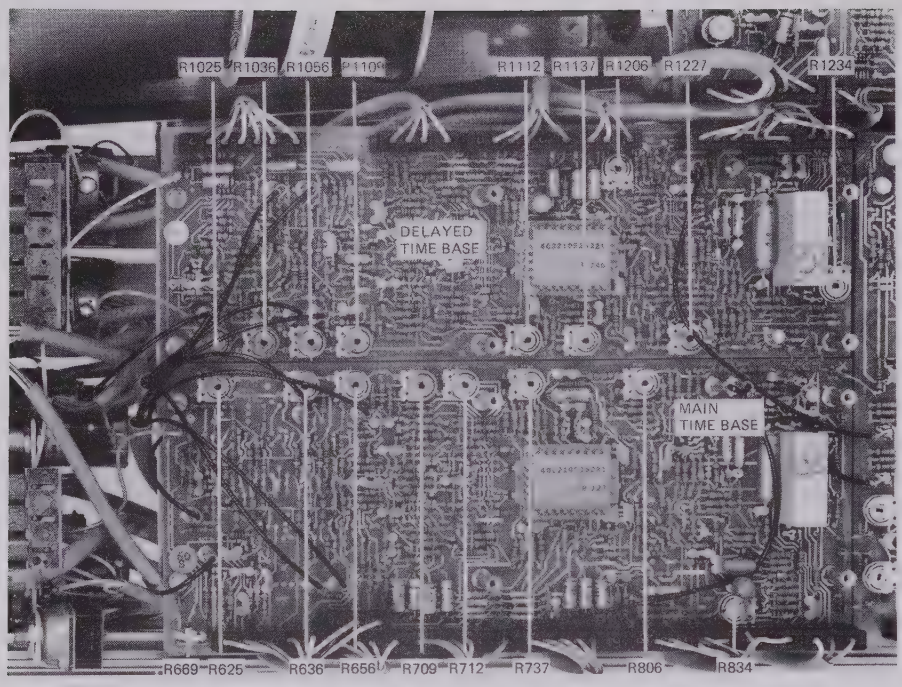


Fig. 3.22. Time-base boards with adjusting references

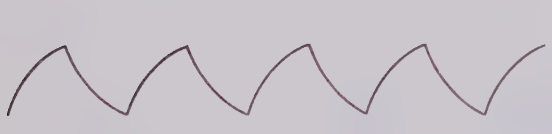


Fig. 3.23. Effect of LF trigger coupling control

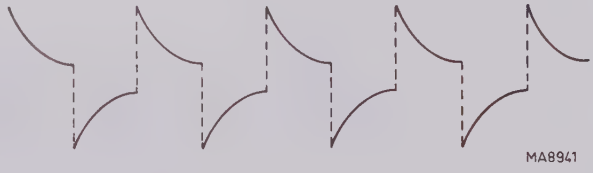


Fig. 3.24. Effect of HF trigger coupling control

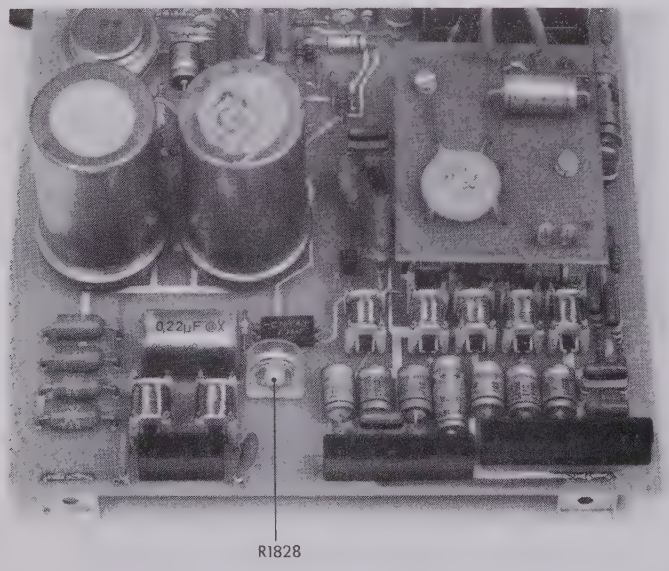


Fig. 3.25. Power supply with adjusting references

3.5. TEST AND REPAIR HINTS

3.5.1. General information

- Use an isolating transformer when measurements must be made in the power supply
- For measuring on the printed-wiring boards, test-pins with sharp points must be used. Be careful not to cause a short-circuit by letting the test-pin slip from the test point.
- Use an appropriate soldering iron and solder with a low melting point, if micro-miniature semi-conductors must be replaced (for recommended iron and solder, refer to section 3.3.15.1.). It is essential to earth the tip of the soldering iron to the mass of the oscilloscope.
- Be very careful not to bend the pins on the neck of the c.r.t., since this is likely to result in a gas-leak
- Do not remove or insert hybrid circuits when the instrument is switched in
- Do not plug and unplug connectors when the instrument is switched in
- Do not touch any trim potentiometers or trimmers before a fault has been located

3.5.2. Y Channels

3.5.2.1. General

If there is a fault in one of the Y channels, it can easily be traced to a certain unit by combining the attenuator of one channel and the intermediate amplifier part of the other channel.
This is simply a matter of plugging coaxial cables. For bias and signal levels, refer to Fig. 3.21.

3.5.2.2. Attenuator

Be careful if a reed relay must be replaced. Such a relay consists of a glass tube, containing the contact points, and a coil. The coil is fitted around the glass tube, with a piece of foil in between for shielding. Since the glass tube is rather fragile, the connection wire of the relay must be bent and soldered with caution. Do not twist the connection wires, as this may cause broken glass-metal seal and unreliable contact inside the glass-tube.

3.5.2.3. Intermediate amplifier

- When you are measuring in the intermediate amplifier, do not remove circuit blocks IC301 and IC351. Blocks IC302 and IC352 supply current to these blocks and the measuring results are not reliable any longer when the load of IC302 and IC352 has been removed.
- If the AMPL vernier control does not work, first check IC353 (for channel A) or IC303 (for channel B).
- If the chopper square-wave is asymmetrical, which shows on the screen as a difference in brilliance of the two traces in the CHOP mode, check circuit block IC306.
- If the common-mode rejection factor is too low, check IC304 and IC354. If necessary, fit a capacitor of 0,8 pF ... 2,2 pF between the soldering tags near the coaxial cable of input A or B on the intermediate amplifier board.

3.5.2.4. Final amplifier

- The coaxial cables between IC401 and the delay line may be unplugged for measurements.
- The final amplifier unit is unaccessible for measurements when it is still inside the oscilloscope. It is, however, possible to take the unit out of the oscilloscope (refer to section 3.3.6.) and operate it there.
  The multipole connector and the 50-Ohm-cables from the delay line must remain connected. The connections to the c.r.t. are too short, but it is possible to bypass the c.r.t. filter and leave it out of the circuit. The bypass can be made by interconnecting the lead from the collector of TS401 and the lead to R420 on the amplifier board, and the lead from TS402 and the lead to R431. In this way, there is a current path and a test oscilloscope may be connected across R420 ... R431. Only l.f. and d.c. measurements are possible, of course, with this method.
- If pulse-top errors arise spontaneously, check the c.r.t. filter for interruptions and contact failure.
  Check also the c.r.t. pins on corrosion.

3.5.3. Triggering

- The input stage can be normally measured on the base of the transistors. On the collectors, however, the signal is current. On the collectors of TS603 and TS618 the signal is voltage again. We refer all the time to components of the main time-base, but the same details apply to the delayed time-base.
- The emitter of TS634 is connected to test point A and the emitter of TS642 to test point B (Fig. 3.22). The signal on these test points in voltage and can be measured with the aid of an oscilloscope.

– Test point C is connected to the base of transistor TS637 (Fig. 3.22). The signal on this point is also voltage.
– Test point D (Fig. 3.22) is connected to point 4 of IC601.
With an input signal of approx. 6 DIV applied to the oscilloscope, a square-wave can be measured on this point.
If this signal is there and the oscilloscope cannot be triggered, the presence of an output signal on point 16 of IC601 must be checked. This signal consists of very narrow negative-going spikes which are best displayed on a sampling oscilloscope. You may also measure the pulses on point 14 of the circuit block. These pulses which are positive-going and control the auto-circuit are not as steep as the ones on point 16 and as such, easier to display.
If there are pulses on point 14, you may almost take it for granted that there are also pulses on point 16.
– If there is no triggering, another fault possibility is stabistor GR606. On point 15 of IC601 is normally a voltage of 9 V, but with a faulty stabistor this voltage will be approx. 15 V.

3.5.4. Time-base generator

– The easiest way to test the time-base generator (we refer here to the main time-base generator, but a similar procedure applies to the delayed time-base) is to remove transistors TS807 and TS808, switch in a low sweep speed and short-circuit the cathode of GR801 to earth. During the time that this short-circuit exists, C807 is charged. The charging process can be traced through the time-base generator, where the changing level must be measured in all circuits.
A fault is then located at a point which does not follow the changing level.
– Transistor TS807 can be removed without disturbing the working of the time-base generator.

3.5.5. Final X amplifier

– To check the d.c. balance of this stage, you may remove transistors TS1704 and TS1706. It is not possible to remove transistors furtheron in the circuit for this measurement, since one half of the circuit has been connected to +110 V and the other half to –110 V.
– All signals in the final X amplifier are currents, but voltage can be measured on the X deflection plates. The voltage on each plate must be approx. 32 V. If one of the plate voltages shows a considerable deviation from this value, the corresponding side of the amplifier must be checked. The most likely fault would be a faulty zener diode.

3.5.6. Z Unit

– If the trace brilliance cannot be turned down with the INTENS control, transistor TS509 and diode GR505 must be checked. The cause may be the following.
If the connection wire of C522 is unplugged while the oscilloscope is operating, capacitor C522 is charged. When the cable is plugged in again, transistor TS509 and may-be diode GR505 are likely to be destroyed by the surge. So if you have disconnected the cable of C522 and you want to plug it in again, switch off the oscilloscope, discharge the capacitor, plug in the cable and switch the oscilloscope on again.
Also be very careful if the unplugged capacitor-cable is dangling about in the circuitry, because this too may cause the same damage.
– If the 2-kV-generator breaks down, check transistor TS2004.

3.6. MAINTENANCE

After removal (see section 3.3.2.) the cabinet plates may be cleaned with a mild non-abrasive household detergent. Do not use chemical solutions such as trichlorethylene and acetone.

The text plate may be cleaned with the same detergent, with alcohol or with white spirit. Always use a soft cloth or cotton wool.

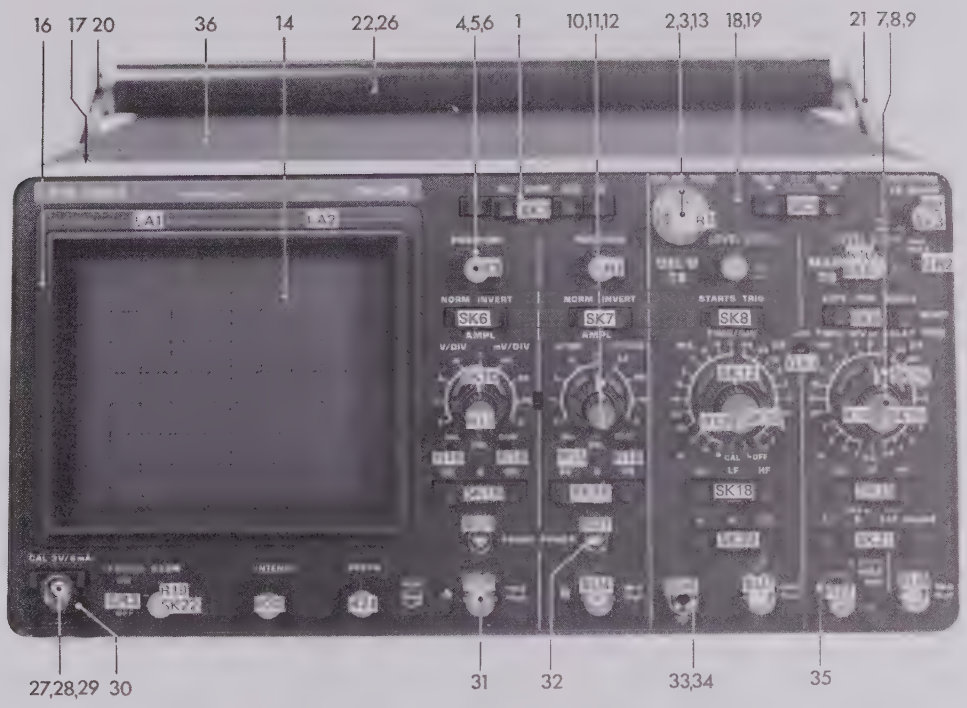


Fig. 3.26. Front view with item numbers and circuit symbols

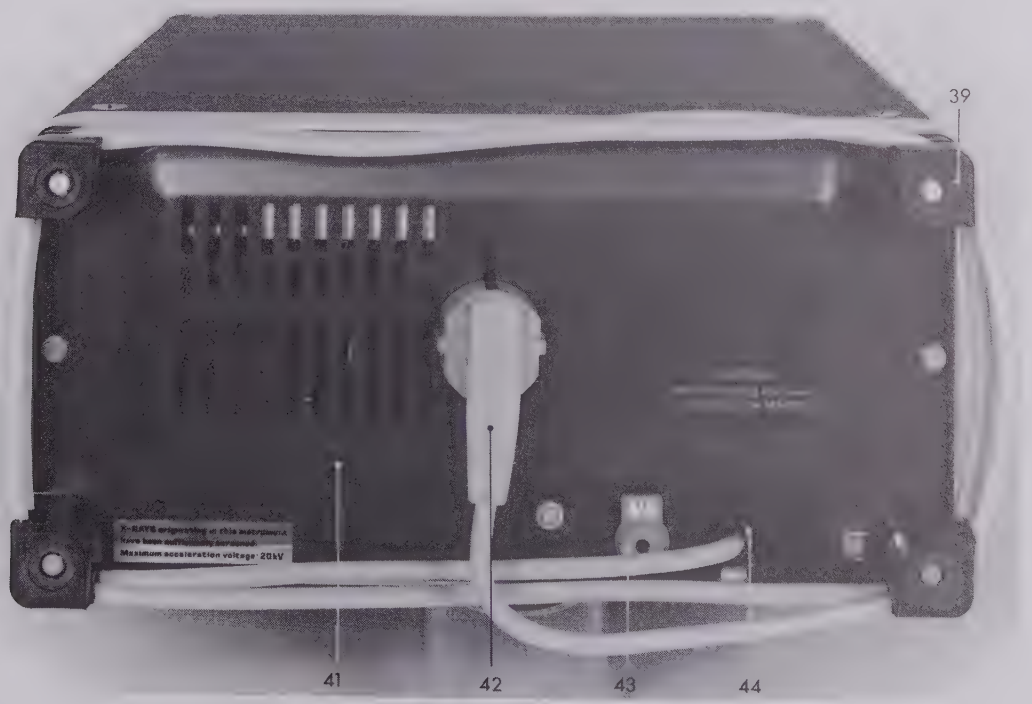


Fig. 3.27. Rear view with item numbers

3.7.1. Parts List

Item	*Fig.*	*Order number*	*Description*
1	3.26	5322 414 14011	Knob for push-button switches
2	3.26	5322 414 34147	Knob with ten-turn dial
3	3.26	5322 414 34133	Knob, dia 10 mm, shaft dia 1/8" for PM 3260E
4	3.26	5322 414 34134	Knob, dia 10 mm
5	3.26	5322 492 64337	Retaining spring for item 4
6	3.26	5322 414 74015	Cover, grey with dash
7	3.26	5322 414 34081	Knob, dia 24 mm, shaft dia 6 mm
8	3.26	5322 414 34119	Control knob, dia 14 mm, shaft dia 4 mm
9	3.26	5322 414 74016	Cover, blue with dash for item 8
10	3.26	5322 414 34079	Knob, dia 18,7 mm, shaft 6 mm
11	3.26	5322 414 34901	Knob, dia 10 mm, shaft 4 mm
12	3.26	5322 414 74029	Cover, blue with dash for item 11
13	3.26	5322 414 74031	Cover, grey with dash for item 3
14	3.26	5322 480 34046	Contrast filter, grey
15	—	5322 480 34074	Contrast filter, blue
16	3.26	5322 451 34004	Bezel
17	3.26	5322 417 24024	Quick fastener complete
18	3.26	5322 455 84043	Text plate for PM 3260
19	3.26	5322 455 84034	Text plate for PM 3260E
20	3.26	5322 498 54044	Bracket, left-hand side
21	3.26	5322 498 54043	Bracket, right-hand side
22	3.26	5322 498 54045	Grip bar
23	3.28	5322 535 74401	Locking pin
24	3.28	5322 492 54155	Spring
25	3.26	5322 498 54082	Handle assy, consisting of items 20, 21 and 22
26	3.26	5322 498 54042	Plastic protection strip for grip
27	3.26	5322 267 14014	CAL socket
28	3.26	5322 505 14184	Plastic nut for item 27
29	—	5322 263 54003	BNC adaptor for item 27
30	3.26	5322 405 94073	Current loop
31	3.26	5322 267 10004	BNC socket
32	3.26	5322 265 30096	Probe power socket
33	3.26	5322 535 80523	Earth socket
34	3.26	5322 505 14178	Serrated nut for item 33
35	3.26	5322 414 74028	Skirt for knob
36	3.26	5322 447 94147	Upper cabinet plate, complete
37	—	5322 447 94146	Lower cabinet plate, complete
38	—	5322 462 44297	Rubber foot
39	3.27	5322 462 44154	Nylon foot, complete
40	—	5322 447 94169	Front cover, complete
41	3.27	5322 447 94148	Rear cabinet plate
42	3.27	5322 321 14066	Mains cable
43	3.27	5322 256 34019	Fuse Holder
44	3.27	5322 325 64061	Cable cleat
45	3.28	5322 447 94143	Cast aluminium front plate
46	3.29	5322 447 94144	Cast aluminium rear plate
47	3.29	5322 447 94145	Aluminium side strip
48	3.30	4822 502 30047	Screw for fitting frames
49	—	5322 532 14174	Earthing ring
50	—	4822 505 10029	Square nut M3 in aluminium side strip of cabinet

Item	*Fig.*	*Order number*	*Description*
51	3.30	5322 532 74014	Sleeve for C.R.T. neck
52	–	5322 462 44153	Clamping buffer for C.R.T. front
53			Male clamping piece
54	–	5322 405 94171	Female clamping piece } Clamping assy for push-button sets
55			Screw M3x20
56	–	5322 532 14526	Filler ring for 10-turn potentiometer in PM 3260E
57	–	5322 492 64394	Earthing leaf spring
58	–	5322 255 44026	10-Way terminal strip
59	–	5322 267 34042	Coax. socket, mounted slanting on final Y-ampl. board
60	–	5322 267 34043	Coax. socket, vertically mounted on p.w. boards
61	3.29	5322 532 24398	Coupling part for spindle
62	–	5322 462 34121	Circuit board support
63	–	5322 505 14185	Special nut for attenuator switch
64	–	5322 395 54023	Special tool for attenuator nut
65	–	5322 505 14186	Special nut for potentiometer unit
66	–	5322 395 54024	Tool for item 65
67	–	5322 255 44088	Hobler for L.E.D.
68	3.29	5322 535 94656	Plastic spindle
69	–	5322 462 54161	C.R.T. screening (3 parts)
70	–	5322 268 44019	BNC connector

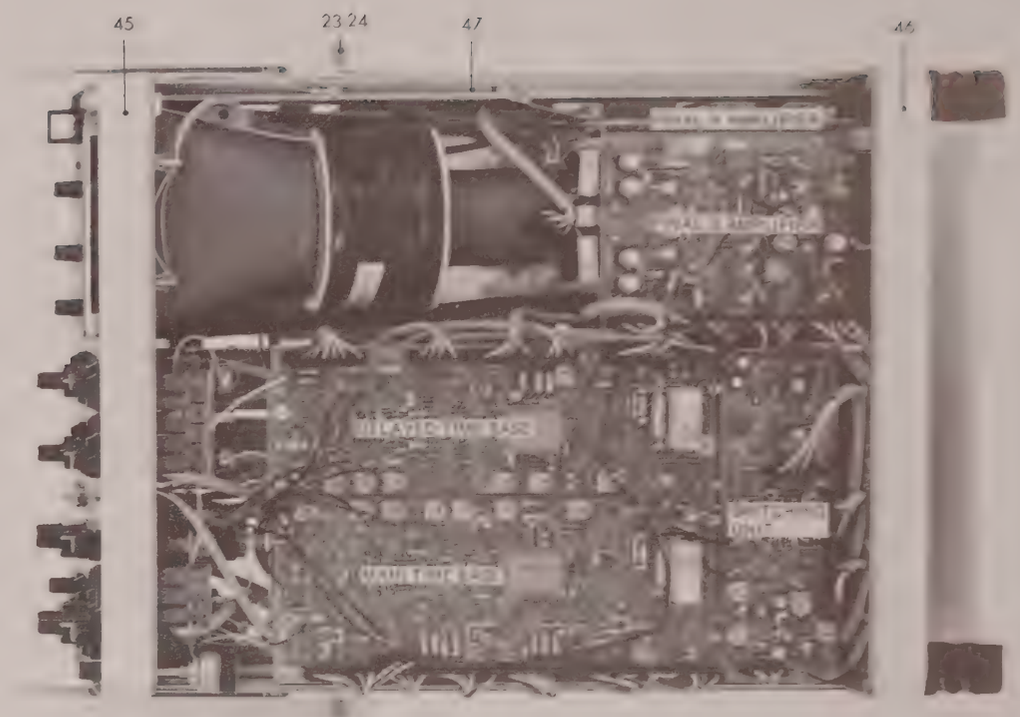


Fig. 3.28. Top view with item numbers

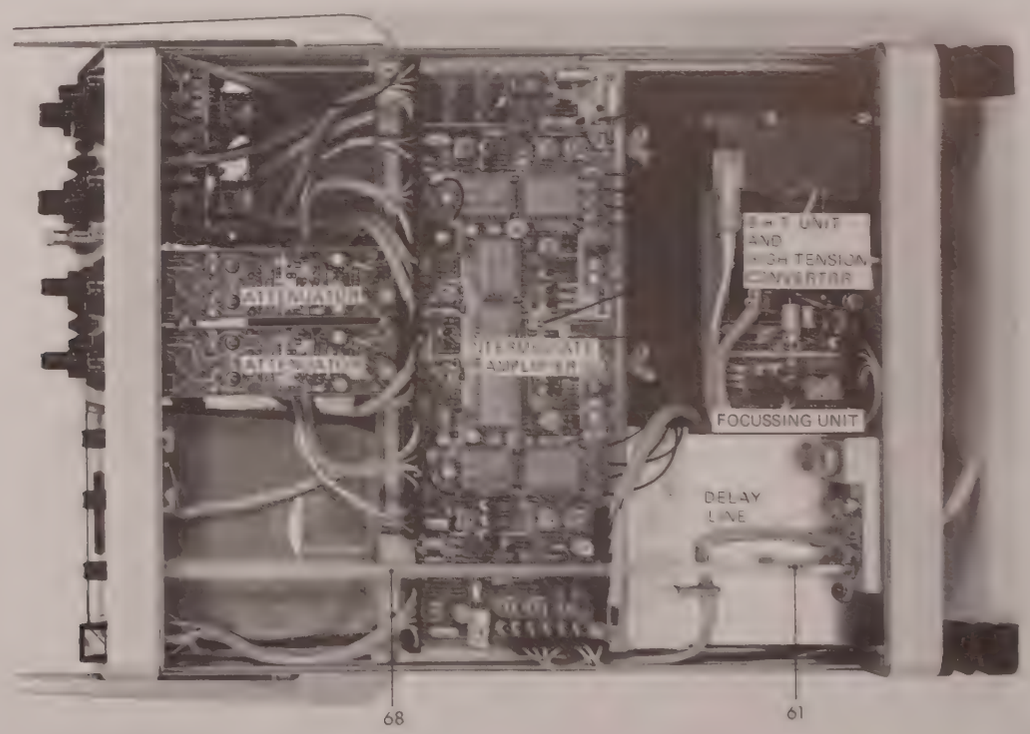


Fig. 3.29. Bottom view with item numbers

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Coaxial cables with connectors at both ends

55	5322 320 14031	440-mm-cable between the trigger outputs of the intermediate amplifier and the trigger inputs of the time-base circuits
56	5322 320 14029	400-mm-cable between the ALT output of the m.t.b. and switching logic on intermediate ampl. board. Also between chopper-blanking output on intermediate ampl. board and Z amplifier.
57	5322 320 14028	300-mm-cable between delay-line output and final Y amplifier.
58	5322 320 14027	500-mm-cable between X output of m.t.b. and X amplifier on switching unit

Multi pole plugs and sockets

59	4822 266 30071	3-pole plug	(Stocko MKF 803-1-0-303)
60	4822 265 30121	3-pole socket	(Stocko MKS 823-1-0-303)
61	4822 266 30072	4-pole plug	(Stocko MKF 804-1-0-404)
62	4822 265 30119	4-pole socket	(Stocko MKS 824-1-0-404)
63	4822 266 30073	6-pole plug	(Stocko MKF 806-1-0-606)
64	4822 265 30117	6-pole socket	(Stocko MKS 826-1-0-606)
65	4822 266 40057	7-pole plug	(Stocko MKF 807-1-0-707)
66	4822 265 40119	7-pole socket	(Stocko MKS 827-1-0-707)

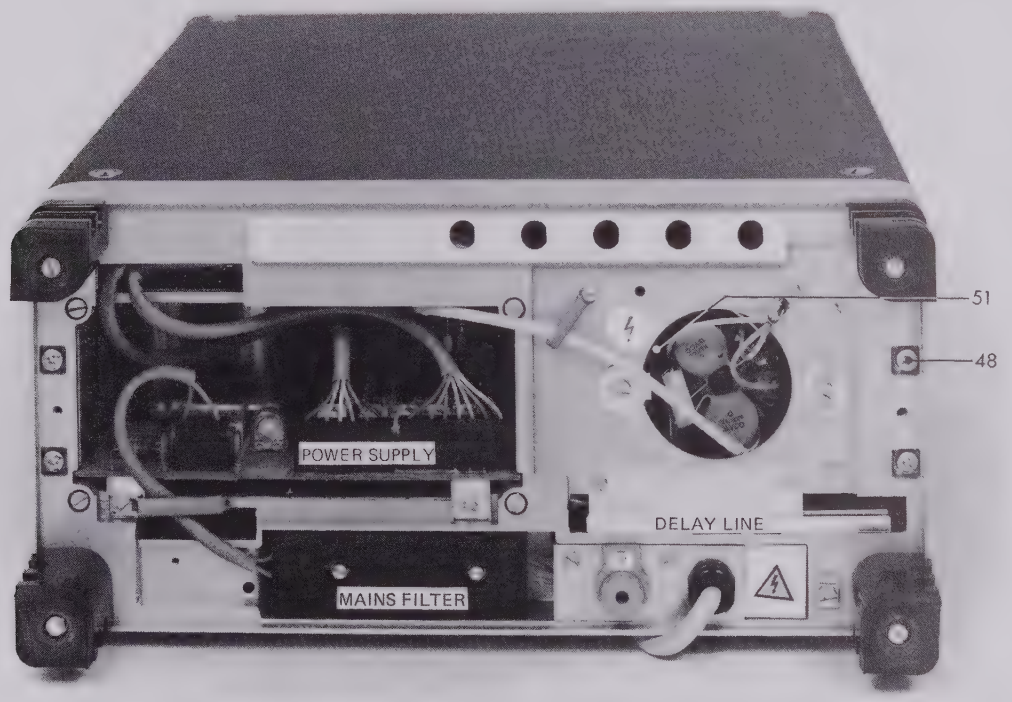


Fig. 3.31. Rear view without rear plate

3.7.2. Electrical parts

Itemnos. (e.g. C--, R--, TS--) have been divided in groups which relate to the circuit unit, according to following table.

1 --- 99	front (or rear) panel of the instrument	
100 --- 199	Y input attenuator	
300 --- 399	Intermediate Y amplifier	
400 --- 499	Final Y amplifier	
500 --- 599	Z amplifier	
600 --- 799	Trigg.	Main time-base generator
800 --- 904	Sweep circuit	
920 --- 999	Switch	
1000 --- 1199	Trigg.	Delayed time-base generator
1200 --- 1299	Sweep circuit	
1300 --- 1399	Switch	
1400 --- 1599	X Defl. selector	
1600 --- 1699	Logic and probe power (interm. Y ampl. p.c.b.)	
1700 --- 1799	Final X amplifier	
1800 --- 1899	Power supply	
1900 --- 1999	Calibration generator	
2000 --- 2099	2 kV converter	

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
CAPACITORS					
C 1	5322 122 14018				CERAMIC TUBULAR
C 2	5322 125 54003				TRIMMER
C 3	5322 125 54051				TRIMMER
C 4	5322 125 50051				TRIMMER
C 101	5322 125 64009	3PF		500	TRIMMER
C 102	5322 125 64015	4,5PF		500	TRIMMER
C 103	5322 123 34001	30PF	10	300	MICA
C 104	4822 121 40278	22NF	10	400	POLYESTER FOIL
C 105	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 106	4822 122 31072	47PF	2	500	CERAMIC PLATE
C 107	5322 125 64012	1,5PF		500	TRIMMER
C 108	5322 125 64014	3PF		500	TRIMMER
C 109	5322 125 64009	3PF		500	TRIMMER
C 111	5322 125 64015	4,5PF		500	TRIMMER
C 112	5322 123 10168	300PF	10	300	MICA
C 113	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 114	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 116	4822 122 31173	220PF	2	500	CERAMIC PLATE
C 117	4822 122 31047	5,6PF	0,25PF	100	CERAMIC PLATE
C 118	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 119	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 120	5322 125 50049	10PF		300	TRIMMER
C 121	4822 122 31125	4,7NF	-20+80	40	CERAMIC PLATE
C 122	4822 124 20452	33UF	-10+50	6,3	ELECTROLYTIC
C 123	4822 122 30027	1NF	-20+80	40	CERAMIC PLATE
C 124	5322 125 50048	3,5PF		300	TRIMMER
C 125	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 126	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 128	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 129	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 130	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 301	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 302	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 303	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 304	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 307	4822 121 40407	22NF	10	250	POLYESTER FOIL
C 309	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 311	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 312	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 313	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 314	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 316	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 317	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 318	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 319	4822 125 50017	65PF		250	TRIMMER
C 322	5322 125 50051	18PF		300	TRIMMER
C 323	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 324	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 325	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 326	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 328	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 329	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 330	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 331	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 332	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 335	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 336	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 337	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 338	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 339	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 341	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 351	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 352	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 353	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 354	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 357	4822 121 40407	22NF	10	250	POLYESTER FOIL
C 361	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 362	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 363	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 364	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 366	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 367	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 368	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 369	4822 125 50017	65PF		250	TRIMMER
C 371	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 372	5322 125 50051	0...22PF	2	100	TRIMMER
C 373	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 374	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 375	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 376	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 377	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 378	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 379	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 380	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 381	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 382	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 384	4822 124 20452	33UF	-10+50	6,3	ELECTROLYTIC
C 385	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 386	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 387	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 388	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 389	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 400	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 401	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 402	4822 122 30057	2,7NF	10	100	CERAMIC PLATE
C 403	4822 122 31169	1,5NF	10	100	CERAMIC PLATE
C 405	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 406	5322 121 44025	33NF	10	250	POLYESTER FOIL
C 407	5322 125 50051	18PF		300	TRIMMER
C 408	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 409	4822 122 31085	150PF	2	100	CERAMIC PLATE
C 410	4822 122 31038	2,7PF	0,25PF	100	CERAMIC PLATE
C 411	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 412	4822 122 31085	150PF	2	100	CERAMIC PLATE
C 413	5322 121 44138	47NF	10	250	POLYESTER FOIL
C 414	5322 121 44138	47NF	10	250	POLYESTER FOIL
C 416	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 417	4822 122 31085	150PF	2	100	CERAMIC PLATE
C 418	4822 122 30104	1PF	0,25PF	100	CERAMIC PLATE
C 419	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 421	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 422	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 423	4822 122 30104	1PF	0,25PF	100	CERAMIC PLATE
C 500	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 501	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 502	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 503	4822 122 31116	2,2NF	10	500	CERAMIC PLATE
C 504	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 505	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 506	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 507	4822 122 30034	470PF	2	100	CERAMIC PLATE
C 508	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 509	5322 125 50048	3,5PF		300	TRIMMER
C 510	4822 122 31197	15PF	2	500	CERAMIC PLATE
C 511	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 513	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 514	4822 122 30098	3,9NF	10	100	CERAMIC PLATE
C 515	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 516	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 517	4822 122 30098	3,9NF	10	100	CERAMIC PLATE
C 518	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 519	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 520	4822 122 31197	15PF	2	500	CERAMIC PLATE
C 521	5322 122 50044	1NF	-20+50	3K	CERAMIC DISK
C 522	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 523	4822 121 40411	33NF	10	250	POLYESTER FOIL
C 524	4822 122 31211	100PF	10	500	CERAMIC PLATE
C 525	5322 125 50048	3,5PF		300	TRIMMER

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 526	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 527	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 528	4822 121 40366	15NF	10	1000	POLYESTER FOIL
C 529	4822 121 40195	33NF	10	1600	POLYESTER FOIL
C 530	5322 122 50001	4,7NF	-20+50	3K	CERAMIC DISK
C 531	4822 121 40429	220NF	10	630	POLYESTER FOIL
C 532	4822 122 31174	2,7NF	10	500	CERAMIC PLATE
C 533	4822 122 31174	2,7NF	10	500	CERAMIC PLATE
C 534	5322 122 50044	1NF	-20+50	3K	CERAMIC DISK
C 536	4822 122 31174	2,7NF	10	500	CERAMIC PLATE
C 537	4822 121 40411	33NF	10	250	POLYESTER FOIL
C 538	4822 121 40411	33NF	10	250	POLYESTER FOIL
C 539	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 541	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 542	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 543	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 547	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 601	4822 122 31192	6,8PF	0,5PF	500	CERAMIC PLATE
C 602	4822 122 31194	8,2PF	0,5PF	500	CERAMIC PLATE
C 604	4822 122 31067	33PF	2	100	CERAMIC PLATE
C 606	4822 122 31067	33PF	2	100	CERAMIC PLATE
C 607	4822 122 30091	390PF	2	100	CERAMIC PLATE
C 608	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 610	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 611	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 612	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 613	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 614	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 616	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 617	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 618	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 619	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 620	4822 122 31067	33PF	2	100	CERAMIC PLATE
C 621	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 622	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 623	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 624	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 625	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 626	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 627	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 629	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 630	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 631	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 634	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 635	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 636	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 637	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 638	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 639	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 642	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 643	5322 124 10014	4,7UF		35	ELECTROLYTIC TANTALUM
C 644	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 645	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 646	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 647	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 648	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 649	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 652	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 800	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 801	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 802	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 803	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 804	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 805	5322 121 54062	4,3NF	1	63	POLYSTYRENE FOIL
C 806	4822 121 50549	442PF	1	250	POLYSTYRENE FOIL
C 807	5322 121 40224	4,7UF	10	100	POLYESTER FOIL
C 808	5322 121 54108	47UF	1	63	POLYSTYRENE FOIL
C 809	5322 124 14057	100UF		10	ELECTROLYTIC TANTALUM
C 810	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 811	4822 121 40427	220NF	10	100	POLYESTER FOIL

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 812	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 813	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 814	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 815	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 816	4822 122 31221	1,5NF	10	100	CERAMIC PLATE
C 818	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 819	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 820	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 821	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 822	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 823	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 824	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 825	4822 122 31219	150PF	10	500	CERAMIC PLATE
C 827	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1001	4822 122 31192	6,8PF	0,5PF	500	CERAMIC PLATE
C 1002	4822 122 31194	8,2PF	0,5PF	500	CERAMIC PLATE
C 1004	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1006	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1007	4822 122 30091	390PF	2	100	CERAMIC PLATE
C 1008	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1010	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 1011	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 1013	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1014	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1017	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 1018	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1019	4822 122 31054	10PF	2	100	CERAMIC PLATE
C 1020	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1021	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1022	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1023	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1024	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1026	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1027	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1029	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1030	4822 122 31061	18PF	2	100	CERAMIC PLATE
C 1031	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1034	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 1035	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 1036	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1037	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1038	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1039	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1040	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1041	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1044	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1045	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1046	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 1047	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1048	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 1049	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1052	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1200	5322 121 54108	47NF	1	63	POLYSTYRENE FOIL
C 1201	4822 122 31058	15PF	2	100	CERAMIC PLATE
C 1202	4822 121 50549	442PF	1	250	POLYSTYRENE FOIL
C 1203	5322 121 40224	4,7UF	10	100	POLYESTER FOIL
C 1204	5322 121 54062	4,3NF	1	63	POLYSTYRENE FOIL
C 1205	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1206	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1207	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1208	4822 122 31221	1,5NF	10	100	CERAMIC PLATE
C 1209	4822 122 31063	22PF	2	100	CERAMIC PLATE
C 1210	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1211	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 1212	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1213	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 1214	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1216	4822 124 20459	22UF	-10+50	10	ELECTROLYTIC
C 1217	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1404	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 1406	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1407	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1408	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1409	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1410	4822 121 41161				POLYESTER FOIL
C 1411	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1412	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1413	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1414	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1415	4822 121 41161				POLYESTER FOIL
C 1416	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1417	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1418	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1419	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1420	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1421	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1422	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1423	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1424	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1602	4822 122 30135	820PF	10	100	CERAMIC PLATE
C 1603	4822 122 31069	39PF	2	100	CERAMIC PLATE
C 1604	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1605	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1606	4822 124 20589	220UF	-10+50	10	ELECTROLYTIC
C 1607	4822 124 20589	220UF	-10+50	10	ELECTROLYTIC
C 1608	4822 122 31175	1NF	10	100	CERAMIC PLATE
C 1609	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1611	4822 122 30045	27PF	2	100	CERAMIC PLATE
C 1621	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1622	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1623	4822 122 31081	100PF	2	100	CERAMIC PLATE
C 1624	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1625	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1626	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1627	4822 121 40522	100NF	10	100	POLYESTER FOIL
C 1628	4822 122 30043	10NF	-20+80	40	CERAMIC PLATE
C 1701	4822 122 31116	2,2NF	10	500	CERAMIC PLATE
C 1702	5322 122 34039	0,56PF	0,25PF	100	CERAMIC PLATE
C 1703	5322 125 50048	3,5PF		300	TRIMMER
C 1704	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1706	4822 121 41161	100NF	10	100	POLYESTER FOIL
C 1707	5322 125 50048	3,5PF		300	TRIMMER
C 1708	5322 122 34039	0,56PF	0,25PF	100	CERAMIC PLATE
C 1709	4822 122 31116	2,2NF	10	500	CERAMIC PLATE
C 1711	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1712	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1713	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1714	4822 121 40239	47NF	10	250	POLYESTER FOIL
C 1716	4822 122 30103	22NF	-20+80	40	CERAMIC PLATE
C 1717	4822 121 40239	47NF	10	250	POLYESTER FOIL
C 1718	4822 124 20475	10UF	-10+50	25	ELECTROLYTIC
C 1800	4822 121 41161	4NF		1000	POLYESTER FOIL
C 1801	5322 121 44142	220NF	10	250	POLYESTER FOIL
C 1802	5322 122 44009	2,2NF	20	250	CERAMIC DISK
C 1803	5322 122 44009	2,2NF	20	250	CERAMIC DISK
C 1804	5322 121 44142	220NF	10	250	POLYESTER FOIL
C 1805	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 1806	4822 124 40066	2x50UF		400	ELECTROLYTIC
C 1807	4822 124 40066	2x50UF		400	ELECTROLYTIC
C 1808	4822 124 20462	100UF	-10+50	10	ELECTROLYTIC
C 1809	5322 124 24153	220UF		100	ELECTROLYTIC
C 1810	4822 124 20581	220UF	-10+50	4	ELECTROLYTIC
C 1811	4822 121 40239	47NF	10	100	POLYESTER FOIL
C 1812	4822 124 20581	220UF	-10+50	4	ELECTROLYTIC
C 1813	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 1814	4822 124 20467	15UF	-10+50	16	ELECTROLYTIC
C 1815	4822 121 40208	1UF	10	250	POLYESTER FOIL
C 1816	4822 121 40104	150NF	10	250	POLYESTER FOIL
C 1817	4822 121 40452	1,5UF	10	100	POLYESTER FOIL
C 1818	4822 124 20483	6,8UF	-10+50	40	ELECTROLYTIC

ITEM	ORDERING NUMBER	FARAD	TOL (%)	VOLTS	REMARKS
C 1819	4822 121 41169	220NF	10	100	POLYESTER FOIL
C 1820	4822 122 31175	1NF	10	100	CERAMIC PLATE
C 1821	4822 121 40407	22NF	10	250	POLYESTER FOIL
C 1822	4822 121 41169	220NF		200	POLYESTER FOIL
C 1823	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1824	4822 124 20465	330UF	-10+50	10	ELECTROLYTIC
C 1825	5322 122 54006	3,3NF	-20+50	3K	CERAMIC DISK
C 1826	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1827	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1828	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1829	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1830	4822 121 40104	150NF	10	250	POLYESTER FOIL
C 1831	4822 124 20501	47UF	-10+50	63	ELECTROLYTIC
C 1832	4822 124 20497	15UF	-10+50	63	ELECTROLYTIC
C 1833	4822 124 20488	100UF	-10+50	40	ELECTROLYTIC
C 1834	4822 124 20485	33UF	-10+50	40	ELECTROLYTIC
C 1835	4822 121 40239	47NF	10	250	POLYESTER FOIL
C 1836	4822 124 20488	100UF	-10+50	40	ELECTROLYTIC
C 1837	4822 124 20485	33UF	-10+50	40	ELECTROLYTIC
C 1840	4822 121 41161	100NF	10	250	POLYESTER FOIL
C 1842	4822 124 20469	68UF	-10+50	16	ELECTROLYTIC
C 1843	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1844	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1845	4822 121 40411	33NF	10	400	POLYESTER FOIL
C 1846	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1847	4822 124 20454	150UF	-10+50	6,3	ELECTROLYTIC
C 1849	4822 122 31177	470PF	10	500	CERAMIC PLATE
C 1851	4822 122 30128	4,7NF	10	100	CERAMIC PLATE
C 1901	4822 124 20468	33UF	-10+50	16	ELECTROLYTIC
C 1902	5322 121 40233	680NF	10	100	POLYESTER FOIL
C 1903	4822 121 50611	20NF	1	63	POLYSTYRENE FOIL
C 1904	4822 124 20453	68UF	-10+50	6,3	ELECTROLYTIC
C 2000	4822 124 20497	15UF	-10+50	63	ELECTROLYTIC
C 2001	4822 124 20501	47UF	-10+50	63	ELECTROLYTIC
C 2002	5322 122 30134	10NF	-20+50	3K	CERAMIC PLATE
C 2003	4822 121 40427	220NF	10	100	POLYESTER FOIL
C 2004	4822 121 40411	33NF	10	250	POLYESTER FOIL
C 2006	4822 122 31175	1NF	10	100	CERAMIC PLATE
C 2007	4822 121 40443	680NF	10	100	POLYESTER FOIL

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
RESISTORS					
R 1	5322 103 64016	5K	5	2W	WIRE-WOUND POTENTIOMETER
R 2	5322 101 44015	50K	20		CARBON POTM LIN + SWITCH
R 3	5322 101 24056	1K	20	0.1W	CARBON POTM LIN
R 4	5322 100 10135	470	20	0.75W	TRIMMING POTM
R 5	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 7	5322 101 24056	1K	20	0.1W	CARBON POTM LIN
R 8	5322 101 64011	100K	20	0.1W	CARBON POTM LIN + SWITCH
R 10	5322 101 64011	100K	20	0.1W	CARBON POTM LIN + SWITCH
R 11	5322 101 24047	22K	20	0.1W	CARBON POTM LIN
R 13	5322 101 40041	4,7K	20	0.25W	CARBON POTM LIN + SWITCH
R 14	5322 101 40041	4,7K	20	0.25W	CARBON POTM LIN + SWITCH
R 15	5322 101 24099	10K	20	0.1W	CARBON POTM LIN
R 16	5322 101 24065	4,7K	20	0.1W	CARBON POTM LIN
R 19	5322 101 24055	25K	20		CARBON POTM LIN
R 20	5322 101 24147	22K	20	0.1W	CARBON POTM LIN
R 21	5322 101 24147	22K	20	0.1W	CARBON POTM LIN
R 22	5322 101 24054	10K	20		CARBON POTM LIN
R 101	5322 116 64048	56	5	0.125W	METAL OXIDE
R 102	5322 116 55218	920K	0,5	MR30	METAL FILM
R 103	5322 116 64052	39	5	0.125W	METAL OXIDE
R 104	5322 116 55067	88,9K	0,25	MR24C	METAL FILM
R 106	5322 116 64069	43	5	0.125W	METAL OXIDE
R 107	5322 116 55239	200K	0,5	MR25	METAL FILM
R 108	5322 116 64045	10	5	0.125W	METAL OXIDE
R 109	5322 116 64047	560	5	0.125W	METAL OXIDE
R 111	5322 116 64047	560	5	0.125W	METAL OXIDE
R 112	5322 116 64069	43	5	0.125W	METAL OXIDE
R 113	5322 116 55153	992K	0,5	SPEC	METAL FILM
R 114	5322 116 64049	47	5	0.125W	METAL OXIDE
R 116	5322 116 55066	8,08K	0,25	MR24C	METAL FILM
R 117	5322 116 64051	15	5	0.125W	METAL OXIDE
R 118	5322 116 64051	15	5	0.125W	METAL OXIDE
R 119	5322 111 30376	100M	5	0,125W	CARBON
R 121	5322 116 54005	3,32K	1	MR25	METAL FILM
R 122	5322 116 54632	14,7K	1	MR25	METAL FILM
R 123	5322 116 54536	750	1	MR25	METAL FILM
R 124	5322 116 54208	210K	1	MR25	METAL FILM
R 125	5322 116 64052	39	5	0.125W	METAL OXIDE
R 126	5322 116 54774	590K	1	MR30	METAL FILM
R 127	5322 116 54696	100K	1	MR25	METAL FILM
R 128	4822 110 53187	1M	5	CR37	CARBON
R 129	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 131	5322 116 54208	210K	1	MR25	METAL FILM
R 132	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 134	4822 110 42227	33M	5	VR37	CARBON
R 139	5322 116 54469	100	1	MR25	METAL FILM
R 148	5322 116 50592	442	1	MR25	METAL FILM
R 149	5322 116 50592	442	1	MR25	METAL FILM
R 151	5322 116 54499	249	1	MR25	METAL FILM
R 200	5322 116 50767	2,15K	1	MR25	METAL FILM
R 205	4822 111 30324	100	5	CR16	CARBON
R 210	4822 111 30324	100	5	CR16	CARBON
R 215	5322 116 54549	1K	1	MR25	METAL FILM
R 220	5322 100 10139	4,7K	20	0.75W	TRIMMING POTM
R 300	5322 111 34165	200K	5	CR16	CARBON
R 301	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 302	5322 116 54608	7,5K	1	MR25	METAL FILM
R 303	5322 116 50586	1,54K	1	MR25	METAL FILM
R 304	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 306	5322 116 54571	1,96K	1	MR25	METAL FILM
R 307	5322 116 50524	3,01K	1	MR25	METAL FILM
R 308	5322 116 54585	3,48K	1	MR25	METAL FILM
R 309	5322 116 54532	649	1	MR25	METAL FILM
R 311	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 312	5322 116 54549	1K	1	MR25	METAL FILM
R 314	5322 116 50729	4,22K	1	MR25	METAL FILM
R 315	5322 116 54516	365	1	MR25	METAL FILM
R 316	5322 100 10143	1K	20	0.75W	TRIMMING POTM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 317	5322 116 54576	2,37K	1	MR25	METAL FILM
R 318	5322 101 14042	22K	20	0.75W	TRIMMING POTM
R 319	5322 116 54549	1K	1	MR25	METAL FILM
R 320	4822 116 30018	1,3K	10	1W	NTC
R 321	5322 116 54585	3,48K	1	MR25	METAL FILM
R 322	5322 116 54532	649	1	MR25	METAL FILM
R 323	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 324	5322 116 54469	100	1	MR25	METAL FILM
R 325	5322 116 54558	8,25K	1	MR25	METAL FILM
R 326	5322 116 54472	105	1	MR25	METAL FILM
R 327	5322 116 55279	2,87K	1	MR25	METAL FILM
R 328	5322 116 54469	100	1	MR25	METAL FILM
R 329	5322 116 55279	2,87K	1	MR25	METAL FILM
R 331	5322 116 50669	205	1	MR25	METAL FILM
R 332	5322 116 54549	1K	1	MR25	METAL FILM
R 333	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 334	5322 116 54585	3,48K	1	MR25	METAL FILM
R 335	5322 116 54459	75	1	MR25	METAL FILM
R 336	5322 116 50664	2,05K	1	MR25	METAL FILM
R 337	5322 116 54549	1K	1	MR25	METAL FILM
R 338	5322 116 50509	4,87K	1	MR25	METAL FILM
R 339	5322 116 50509	4,87K	1	MR25	METAL FILM
R 340	5322 116 54549	1K	1	MR25	METAL FILM
R 341	5322 116 54549	1K	1	MR25	METAL FILM
R 342	5322 116 54557	1,21K	1	MR25	METAL FILM
R 343	5322 116 54519	402	1	MR25	METAL FILM
R 344	5322 116 50491	22,6	1	MR25	METAL FILM
R 345	5322 116 54469	100	1	MR25	METAL FILM
R 346	5322 116 50459	422	1	MR25	METAL FILM
R 347	5322 116 50583	5,9K	1	MR25	METAL FILM
R 348	5322 116 54608	7,5K	1	MR25	METAL FILM
R 349	5322 116 50728	1,87K	1	MR25	METAL FILM
R 350	5322 111 34165	200K	5	CR16	CARBON
R 351	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 352	5322 116 54608	7,5K	1	MR25	METAL FILM
R 353	5322 116 50586	1,54K	1	MR25	METAL FILM
R 354	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 356	5322 116 54571	1,96K	1	MR25	METAL FILM
R 357	5322 116 50524	3,01K	1	MR25	METAL FILM
R 358	5322 116 54585	3,48K	1	MR25	METAL FILM
R 359	5322 116 54532	649	1	MR25	METAL FILM
R 361	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 362	5322 116 54549	1K	1	MR25	METAL FILM
R 363	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 364	5322 116 50729	4,22K	1	MR25	METAL FILM
R 365	5322 116 54516	365	1	MR25	METAL FILM
R 366	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 367	5322 116 54576	2,37K	1	MR25	METAL FILM
R 368	5322 101 14042	22K	20	0.75W	TRIMMING POTM
R 369	5322 116 54549	1K	1	MR25	METAL FILM
R 370	4822 116 30018	1,3K	10	1W	NTC
R 371	5322 116 54585	3,48K	1	MR25	METAL FILM
R 372	5322 116 54532	649	1	MR25	METAL FILM
R 373	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 374	5322 116 54469	100	1	MR25	METAL FILM
R 375	5322 116 54558	8,25K	1	MR25	METAL FILM
R 376	5322 116 54472	105	1	MR25	METAL FILM
R 377	5322 116 55279	2,87K	1	MR25	METAL FILM
R 378	5322 116 54469	100	1	MR25	METAL FILM
R 379	5322 116 55279	2,87K	1	MR25	METAL FILM
R 381	5322 116 50669	205	1	MR25	METAL FILM
R 382	5322 116 54549	1K	1	MR25	METAL FILM
R 383	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 384	5322 116 54585	3,48K	1	MR25	METAL FILM
R 386	5322 116 50664	2,05K	1	MR25	METAL FILM
R 387	5322 116 54549	1K	1	MR25	METAL FILM
R 388	5322 116 50509	4,87K	1	MR25	METAL FILM
R 389	5322 116 50509	4,87K	1	MR25	METAL FILM
R 391	5322 116 54549	1K	1	MR25	METAL FILM
R 392	5322 116 54557	1,21K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 393	5322 116 54519	402	1	MR25	METAL FILM
R 394	5322 116 50491	22,6	1	MR25	METAL FILM
R 395	5322 116 54469	100	1	MR25	METAL FILM
R 396	5322 116 54459	75	1	MR25	METAL FILM
R 400	5322 116 54536	750	1	MR25	METAL FILM
R 401	5322 116 54448	59	1	MR25	METAL FILM
R 402	5322 116 54448	59	1	MR25	METAL FILM
R 403	5322 116 50729	4,22K	1	MR25	METAL FILM
R 404	5322 116 50524	3,01K	1	MR25	METAL FILM
R 405	5322 116 50508	487	1	MR25	METAL FILM
R 406	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 407	5322 116 50479	15,4K	1	MR25	METAL FILM
R 408	5322 100 10138	100	20	0.75W	TRIMMING POTM
R 409	5322 101 14056	47K	20	0.75W	TRIMMING POTM
R 410	5322 101 14056	47K	20	0.75W	TRIMMING POTM
R 411	5322 116 50767	2,15K	1	MR25	METAL FILM
R 412	5322 116 54696	100K	1	MR25	METAL FILM
R 413	5322 116 54696	100K	1	MR25	METAL FILM
R 414	5322 116 50767	2,15K	1	MR25	METAL FILM
R 417	5322 111 30378	200	5	CR16	CARBON
R 418	5322 116 64005	200	5	5E	METAL OXIDE
R 419	5322 116 54466	90,9	1	MR25	METAL FILM
R 421	5322 116 54466	90,9	1	MR25	METAL FILM
R 422	5322 116 50592	442	1	MR25	METAL FILM
R 423	5322 101 14093	50	20	0,5W	TRIMMING POTM
R 424	5322 116 54466	90,9	1	MR25	METAL FILM
R 426	5322 116 54466	90,9	1	MR25	METAL FILM
R 427	5322 116 64005	200	5	5E	METAL OXIDE
R 428	5322 111 30378	200	5	CR16	CARBON
R 429	5322 116 50664	2,05K	1	MR25	METAL FILM
R 430	5322 116 54603	6,49K	1	MR25	METAL FILM
R 432	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 433	5322 116 54536	750	1	MR25	METAL FILM
R 434	5322 116 54536	750	1	MR25	METAL FILM
R 436	5322 116 54565	1,62K	1	MR25	METAL FILM
R 506	5322 116 54442	51,1	1	MR25	METAL FILM
R 507	5322 116 54442	51,1	1	MR25	METAL FILM
R 508	5322 116 54562	1,4K	1	MR25	METAL FILM
R 509	5322 116 50557	46,4K	1	MR25	METAL FILM
R 511	5322 116 54743	301K	1	MR25	METAL FILM
R 512	5322 116 54623	11K	1	MR25	METAL FILM
R 513	5322 116 50635	1,47K	1	MR25	METAL FILM
R 514	5322 116 54005	3,32K	1	MR25	METAL FILM
R 516	5322 116 54005	3,32K	1	MR25	METAL FILM
R 517	5322 116 50664	2,05K	1	MR25	METAL FILM
R 518	5322 116 54661	34,8K	1	MR25	METAL FILM
R 519	5322 116 54536	750	1	MR25	METAL FILM
R 520	4822 110 63036	2,2	5	CR25	CARBON
R 521	5322 116 54689	82,5K	1	MR25	METAL FILM
R 522	5322 116 50492	46,4	1	MR25	METAL FILM
R 523	5322 116 54462	82,5	1	MR25	METAL FILM
R 524	5322 116 50524	3,01K	1	MR25	METAL FILM
R 525	5322 116 50536	464	1	MR25	METAL FILM
R 526	5322 116 50492	46,4	1	MR25	METAL FILM
R 528	5322 116 50492	46,4	1	MR25	METAL FILM
R 529	5322 116 55151	464	1	MR30	METAL FILM
R 530	5322 116 50491	22,6	1	MR25	METAL FILM
R 531	5322 116 54635	16,9K	1	MR25	METAL FILM
R 532	5322 116 54665	40,2K	1	MR25	METAL FILM
R 533	5322 116 50767	2,15K	1	MR25	METAL FILM
R 534	5322 116 50559	27,4K	1	MR25	METAL FILM
R 536	5322 116 50608	6,19K	1	MR25	METAL FILM
R 537	5322 116 54005	3,32K	1	MR25	METAL FILM
R 538	5322 116 54623	11K	1	MR25	METAL FILM
R 540	5322 116 50536	464	1	MR25	METAL FILM
R 541	5322 116 54689	82,5K	1	MR25	METAL FILM
R 542	5322 116 50536	464	1	MR25	METAL FILM
R 543	5322 116 54623	11K	1	MR25	METAL FILM
R 544	5322 116 50557	46,4K	1	MR25	METAL FILM
R 546	5322 116 55276	13,3K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 547	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 548	5322 116 54576	2,37K	1	MR25	METAL FILM
R 549	5322 116 50608	6,19K	1	MR25	METAL FILM
R 550	5322 116 54619	10K	1	MR25	METAL FILM
R 551	5322 116 54005	3,32K	1	MR25	METAL FILM
R 552	5322 116 54623	11K	1	MR25	METAL FILM
R 553	5322 116 54689	82,5K	1	MR25	METAL FILM
R 554	5322 116 54623	11K	1	MR25	METAL FILM
R 555	5322 116 50536	464	1	MR25	METAL FILM
R 556	5322 116 50557	46,4K	1	MR25	METAL FILM
R 557	5322 116 50536	464	1	MR25	METAL FILM
R 558	5322 116 50557	46,4K	1	MR25	METAL FILM
R 559	5322 116 54623	11K	1	MR25	METAL FILM
R 560	5322 116 54743	301K	1	MR25	METAL FILM
R 561	5322 116 54619	10K	1	MR25	METAL FILM
R 562	5322 116 54641	19,6K	1	MR25	METAL FILM
R 563	5322 116 50729	4,22K	1	MR25	METAL FILM
R 564	4822 110 63187	1M	5	CR25	CARBON
R 565	5322 116 54549	1K	1	MR25	METAL FILM
R 566	4822 110 63187	1M	5	CR25	CARBON
R 567	4822 110 63161	100K	5	CR25	CARBON
R 568	5322 101 14094	1M	20	0,5W	TRIMMING POTM
R 569	4822 110 63187	1M	5	CR25	CARBON
R 570	4822 110 63107	1K	5	CR25	CARBON
R 571	4822 110 63187	1M	5	CR25	CARBON
R 572	5322 116 54619	10K	1	MR25	METAL FILM
R 573	4822 110 42223	22M	5	VR37	CARBON
R 574	4822 110 42216	12M	5	VR37	CARBON
R 575	5322 116 64029	5,6M	5	VR68	METAL OXIDE
R 576	4822 110 42205	4,7M	5	VR37	CARBON
R 577	4822 110 63196	2,2M	10	CR25	CARBON
R 578	4822 110 63196	2,2M	10	CR25	CARBON
R 579	5322 101 14094	1M	20	0,5W	TRIMMING POTM
R 580	5322 116 54549	1K	1	MR25	METAL FILM
R 581	5322 116 54619	10K	1	MR25	METAL FILM
R 582	5322 116 54701	110K	1	MR25	METAL FILM
R 583	5322 116 54701	110K	1	MR25	METAL FILM
R 584	5322 116 54674	53,6K	1	MR25	METAL FILM
R 585	5322 116 50491	22,6	1	MR25	METAL FILM
R 586	5322 116 54674	53,6K	1	MR25	METAL FILM
R 587	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 588	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 589	5322 101 14048	47K	20	0,5W	TRIMMING POTM
R 590	4822 111 30324	100	5	CR16	CARBON
R 591	5322 116 54469	100	1	MR25	METAL FILM
R 592	5322 116 54492	178	1	MR25	METAL FILM
R 593	5322 116 54946	64,9	1	MR30	METAL FILM
R 594	5322 116 55026	330	5	PR37	METAL FILM
R 595	5322 116 54589	3,83K	1	MR25	METAL FILM
R 596	5322 116 50675	2,26K	1	MR25	METAL FILM
R 597	4822 110 63107	1K	5	CR25	CARBON
R 600	5322 116 51052	42,2	1	MR25	METAL FILM
R 601	5322 116 54195	825K	1	MR30	METAL FILM
R 602	5322 116 54721	178K	1	MR25	METAL FILM
R 604	5322 111 30396	22	5	CR16	CARBON
R 605	5322 116 54619	10K	1	MR25	METAL FILM
R 606	4822 110 63207	5,6M	10	CR25	CARBON
R 607	4822 110 63207	5,6M	10	CR25	CARBON
R 608	4822 111 30324	100	5	CR16	CARBON
R 609	5322 111 30396	22	5	CR16	CARBON
R 610	5322 116 54619	10K	1	MR25	METAL FILM
R 611	5322 116 54558	8,25K	1	MR25	METAL FILM
R 612	5322 116 54469	100	1	MR25	METAL FILM
R 613	5322 116 54541	825	1	MR25	METAL FILM
R 614	5322 116 50506	154	1	MR25	METAL FILM
R 615	5322 116 54497	226	1	MR25	METAL FILM
R 616	5322 116 54619	10K	1	MR25	METAL FILM
R 617	5322 116 50481	22,6K	1	MR25	METAL FILM
R 618	5322 116 54529	619	1	MR25	METAL FILM
R 619	4822 111 30348	27	5	CR16	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 620	5322 116 50572	12,1K	1	MR25	METAL FILM
R 621	5322 111 30396	22	5	CR16	CARBON
R 622	5322 111 30074	56	5	CR16	CARBON
R 623	5322 116 54469	100	1	MR25	METAL FILM
R 624	5322 111 30074	56	5	CR16	CARBON
R 625	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 626	5322 116 54467	93,1	1	MR25	METAL FILM
R 627	5322 116 54529	619	1	MR25	METAL FILM
R 628	5322 116 54534	681	1	MR25	METAL FILM
R 632	5322 111 30288	47K	5	CR16	CARBON
R 633	4822 111 30348	27	5	CR16	CARBON
R 634	5322 116 54515	348	1	MR25	METAL FILM
R 635	5322 111 30074	56	5	CR16	CARBON
R 636	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 637	5322 116 50524	3,01K	1	MR25	METAL FILM
R 638	5322 111 30074	56	5	CR16	CARBON
R 639	5322 116 54534	681	1	MR25	METAL FILM
R 641	5322 116 50561	590	1	MR25	METAL FILM
R 642	5322 116 54469	100	1	MR25	METAL FILM
R 643	5322 111 30074	56	5	CR16	CARBON
R 644	5322 116 50524	3,01K	1	MR25	METAL FILM
R 645	5322 111 30074	56	5	CR16	CARBON
R 646	5322 116 50524	3,01K	1	MR25	METAL FILM
R 647	4822 111 30348	27	5	CR16	CARBON
R 648	5322 111 30074	56	5	CR16	CARBON
R 649	5322 116 54469	100	1	MR25	METAL FILM
R 650	5322 111 30074	56	5	CR16	CARBON
R 651	5322 116 50561	590	1	MR25	METAL FILM
R 652	5322 111 30074	56	5	CR16	CARBON
R 653	5322 116 54534	681	1	MR25	METAL FILM
R 654	5322 116 50524	3,01K	1	MR25	METAL FILM
R 655	5322 111 30074	56	5	CR16	CARBON
R 656	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 657	5322 116 50506	154	1	MR25	METAL FILM
R 658	4822 111 30348	27	5	CR16	CARBON
R 669	5322 101 14066	10K	20	0.5W	TRIMMING POTM
R 671	5322 111 30074	56	5	CR16	CARBON
R 672	5322 116 54469	100	1	MR25	METAL FILM
R 673	5322 116 50561	590	1	MR25	METAL FILM
R 674	5322 111 30074	56	5	CR16	CARBON
R 676	5322 116 54534	681	1	MR25	METAL FILM
R 677	5322 116 50491	22,6	1	MR25	METAL FILM
R 678	5322 116 50524	3,01K	1	MR25	METAL FILM
R 679	5322 116 54696	100K	1	MR25	METAL FILM
R 680	5322 111 30396	22	5	CR16	CARBON
R 681	5322 116 50524	3,01K	1	MR25	METAL FILM
R 682	5322 116 54541	825	1	MR25	METAL FILM
R 683	5322 116 50557	46,4K	1	MR25	METAL FILM
R 684	5322 116 54011	5,62K	1	MR25	METAL FILM
R 685	5322 116 50491	22,6	1	MR25	METAL FILM
R 686	5322 116 54696	100K	1	MR25	METAL FILM
R 687	5322 116 50515	1,78K	1	MR25	METAL FILM
R 688	5322 116 50767	2,15K	1	MR25	METAL FILM
R 689	5322 116 54549	1K	1	MR25	METAL FILM
R 691	5322 116 54549	1K	1	MR25	METAL FILM
R 692	5322 116 50484	4,64K	1	MR25	METAL FILM
R 693	5322 116 54619	10K	1	MR25	METAL FILM
R 694	5322 116 54549	1K	1	MR25	METAL FILM
R 696	5322 116 50515	1,78K	1	MR25	METAL FILM
R 697	5322 116 50767	2,15K	1	MR25	METAL FILM
R 698	5322 116 50524	3,01K	1	MR25	METAL FILM
R 699	5322 116 54541	825	1	MR25	METAL FILM
R 700	5322 111 30396	22	5	CR16	CARBON
R 701	5322 116 54529	619	1	MR25	METAL FILM
R 702	5322 116 54536	750	1	MR25	METAL FILM
R 703	5322 116 54554	1,1K	1	MR25	METAL FILM
R 704	5322 111 30396	22	5	CR16	CARBON
R 705	5322 116 50491	22,6	1	MR25	METAL FILM
R 706	4822 111 30067	33	5	CR16	CARBON
R 707	5322 116 50586	1,54K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 708	5322 116 50664	2,05K	1	MR25	METAL FILM
R 709	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 711	5322 116 54549	1K	1	MR25	METAL FILM
R 712	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 713	5322 116 54619	10K	1	MR25	METAL FILM
R 714	5322 116 50586	1,54K	1	MR25	METAL FILM
R 716	5322 116 50484	4,64K	1	MR25	METAL FILM
R 717	5322 116 54549	1K	1	MR25	METAL FILM
R 718	5322 116 50586	1,54K	1	MR25	METAL FILM
R 719	5322 116 54529	619	1	MR25	METAL FILM
R 721	5322 116 54529	619	1	MR25	METAL FILM
R 722	5322 116 50572	12,1K	1	MR25	METAL FILM
R 723	5322 116 54549	1K	1	MR25	METAL FILM
R 724	5322 116 54529	619	1	MR25	METAL FILM
R 726	5322 116 54536	750	1	MR25	METAL FILM
R 727	5322 111 30396	22	5	CR16	CARBON
R 728	4822 111 30067	33	5	CR16	CARBON
R 729	5322 116 54554	1,1K	1	MR25	METAL FILM
R 731	5322 111 30396	22	5	CR16	CARBON
R 732	4822 111 30352	82	5	CR16	CARBON
R 733	5322 111 30396	22	5	CR16	CARBON
R 734	5322 116 54585	3,48K	1	MR25	METAL FILM
R 735	4822 111 30347	10	5	CR16	CARBON
R 736	5322 116 54592	4,02K	1	MR25	METAL FILM
R 737	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 738	5322 116 54624	11,5K	1	MR25	METAL FILM
R 739	5322 116 50515	1,78K	1	MR25	METAL FILM
R 741	5322 116 54558	8,25K	1	MR25	METAL FILM
R 742	5322 116 54549	1K	1	MR25	METAL FILM
R 743	4822 111 30324	100	5	CR16	CARBON
R 744	5322 116 54592	4,02K	1	MR25	METAL FILM
R 745	5322 111 30365	51	5	CR16	CARBON
R 746	5322 111 30396	22	5	CR16	CARBON
R 747	5322 111 44153	15	5	CR16	CARBON
R 748	5322 116 54515	348	1	MR25	METAL FILM
R 749	5322 116 54515	348	1	MR25	METAL FILM
R 751	5322 111 30396	22	5	CR16	CARBON
R 752	5322 111 44153	15	5	CR16	CARBON
R 753	5322 111 30396	22	5	CR16	CARBON
R 754	5322 111 30396	22	5	CR16	CARBON
R 755	4822 111 30347	10	5	CR16	CARBON
R 756	4822 111 30352	82	5	CR16	CARBON
R 757	5322 116 50572	12,1K	1	MR25	METAL FILM
R 758	5322 116 50524	3,01K	1	MR25	METAL FILM
R 759	5322 116 50484	4,64K	1	MR25	METAL FILM
R 760	5322 116 50664	2,05K	1	MR25	METAL FILM
R 761	5322 116 54508	301	1	MR25	METAL FILM
R 762	5322 116 54565	1,62K	1	MR25	METAL FILM
R 763	5322 111 30297	2K	5	CR16	CARBON
R 764	5322 116 54469	100	1	MR25	METAL FILM
R 765	5322 116 54469	100	1	MR25	METAL FILM
R 766	4822 111 30272	680	5	CR16	CARBON
R 767	4822 110 63036	2,2	5	CR25	CARBON
R 768	4822 110 63036	2,2	5	CR25	CARBON
R 769	4822 110 63036	2,2	5	CR25	CARBON
R 771	4822 110 63036	2,2	5	CR25	CARBON
R 801	4822 111 30347	10	5	CR16	CARBON
R 802	5322 116 50904	30,1	1	MR25	METAL FILM
R 803	5322 116 54508	301	1	MR25	METAL FILM
R 804	5322 116 50675	2,26K	1	MR25	METAL FILM
R 805	5322 116 54624	11,5K	1	MR25	METAL FILM
R 806	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 807	5322 116 54619	10K	1	MR25	METAL FILM
R 808	5322 116 55279	2,87K	1	MR25	METAL FILM
R 809	5322 116 54011	5,62K	1	MR25	METAL FILM
R 810	5322 116 54511	316	1	MR25	METAL FILM
R 811	5322 116 54587	3,65K	1	MR25	METAL FILM
R 812	5322 116 54482	133	1	MR25	METAL FILM
R 813	5322 116 54558	8,25K	1	MR25	METAL FILM
R 814	5322 116 50506	154	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 815	5322 116 54532	649	1	MR25	METAL FILM
R 816	5322 116 54696	100K	1	MR25	METAL FILM
R 817	5322 116 54619	10K	1	MR25	METAL FILM
R 818	5322 116 54549	1K	1	MR25	METAL FILM
R 819	5322 116 54442	51,1	1	MR25	METAL FILM
R 820	5322 116 50579	3,16K	1	MR25	METAL FILM
R 821	5322 116 54497	226	1	MR25	METAL FILM
R 822	5322 116 50491	22,6	1	MR25	METAL FILM
R 823	5322 116 50491	22,6	1	MR25	METAL FILM
R 824	5322 116 54595	5,11K	1	MR25	METAL FILM
R 825	5322 116 50452	10	1	MR25	METAL FILM
R 826	4822 111 30067	33	5	CR16	CARBON
R 827	5322 116 54619	10K	1	MR25	METAL FILM
R 828	5322 116 54608	7,5K	1	MR25	METAL FILM
R 829	5322 116 50664	2,05K	1	MR25	METAL FILM
R 831	5322 116 50636	2,74K	1	MR25	METAL FILM
R 834	5322 100 10114	4,7K	20	0.5W	TRIMMING POTM
R 836	5322 116 50481	22,6K	1	MR25	METAL FILM
R 837	5322 116 54632	14,7K	1	MR25	METAL FILM
R 838	5322 116 54721	178K	1	MR25	METAL FILM
R 839	5322 116 54479	127	1	MR25	METAL FILM
R 841	5322 116 50479	15,4K	1	MR25	METAL FILM
R 842	5322 116 54635	16,9K	1	MR25	METAL FILM
R 843	5322 116 54635	16,9K	1	MR25	METAL FILM
R 844	5322 116 50675	2,26K	1	MR25	METAL FILM
R 846	5322 116 55274	215	1	MR25	METAL FILM
R 847	5322 116 55279	2,87K	1	MR25	METAL FILM
R 848	5322 116 50509	4,87K	1	MR25	METAL FILM
R 849	5322 116 54562	1,4K	1	MR25	METAL FILM
R 850	5322 116 54009	562	1	MR25	METAL FILM
R 851	5322 116 54519	402	1	MR25	METAL FILM
R 852	5322 116 54532	649	1	MR25	METAL FILM
R 853	5322 116 50515	1,78K	1	MR25	METAL FILM
R 854	5322 116 50491	22,6	1	MR25	METAL FILM
R 855	5322 116 50559	27,4K	1	MR25	METAL FILM
R 856	5322 116 54009	562	1	MR25	METAL FILM
R 857	5322 116 54009	562	1	MR25	METAL FILM
R 858	5322 116 50559	27,4K	1	MR25	METAL FILM
R 859	5322 116 50559	27,4K	1	MR25	METAL FILM
R 860	5322 116 50675	2,26K	1	MR25	METAL FILM
R 861	5322 116 50675	2,26K	1	MR25	METAL FILM
R 862	5322 116 50675	2,26K	1	MR25	METAL FILM
R 863	5322 116 50636	2,74K	1	MR25	METAL FILM
R 864	5322 116 50636	2,74K	1	MR25	METAL FILM
R 865	5322 116 50636	2,74K	1	MR25	METAL FILM
R 866	5322 116 50452	10	1	MR25	METAL FILM
R 867	5322 116 50491	22,6	1	MR25	METAL FILM
R 868	5322 116 54641	19,6K	1	MR25	METAL FILM
R 869	5322 116 54585	3,48K	1	MR25	METAL FILM
R 870	5322 116 54005	3,32K	1	MR25	METAL FILM
R 871	5322 116 50726	36,5K	1	MR25	METAL FILM
R 872	5322 116 50726	36,5K	1	MR25	METAL FILM
R 873	5322 116 50491	22,6	1	MR25	METAL FILM
R 874	5322 116 50491	22,6	1	MR25	METAL FILM
R 875	4822 111 30311	3,9K	5	CR16	CARBON
R 876	4822 111 30245	47	5	CR16	CARBON
R 877	4822 111 30352	82	5	CR16	CARBON
R 878	5322 111 30279	33K	5	CR16	CARBON
R 881	5322 116 54655	30,1K	1	MR25	METAL FILM
R 882	5322 116 54549	1K	1	MR25	METAL FILM
R 883	5322 116 50536	464	1	MR25	METAL FILM
R 889	5322 116 54619	10K	1	MR25	METAL FILM
R 891	5322 116 50508	487	1	MR25	METAL FILM
R 893	5322 116 54637	17,8K	1	MR25	METAL FILM
R 894	5322 116 50572	12,1K	1	MR25	METAL FILM
R 896	5322 116 54689	82,5K	1	MR25	METAL FILM
R 897	5322 116 54608	7,5K	1	MR25	METAL FILM
R 898	5322 116 50592	442	1	MR25	METAL FILM
R 899	5322 116 54643	20,5K	1	MR25	METAL FILM
R 901	4822 110 63036	2,2	5	CR25	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 902	4822 110 63036	2,2	5	CR25	CARBON
R 903	4822 110 63036	2,2	5	CR25	CARBON
R 904	4822 110 63036	2,2	5	CR25	CARBON
R 921	5322 116 54902	876K	0,25	MR54C	METAL FILM
R 922	5322 116 54901	887K	0,25	MR54C	METAL FILM
R 923	5322 116 54896	354K	0,25	MR34C	METAL FILM
R 924	5322 116 54899	176K	0,25	MR34C	METAL FILM
R 926	5322 116 54897	87,6K	0,25	MR24C	METAL FILM
R 927	5322 116 54895	34,6K	0,25	MR24C	METAL FILM
R 928	5322 116 54894	16,8K	0,25	MR24C	METAL FILM
R 929	5322 116 55161	7,96K	0,25	MR24C	METAL FILM
R 931	5322 116 50784	2,67K	0,25	MR24C	METAL FILM
R 932	5322 116 54898	887	0,25	MR24C	METAL FILM
R 1000	5322 116 51052	42,2	1	MR25	METAL FILM
R 1001	5322 116 54195	825K	1	MR30	METAL FILM
R 1002	5322 116 54721	178K	1	MR25	METAL FILM
R 1005	5322 116 54619	10K	1	MR25	METAL FILM
R 1006	4822 110 63207	5,6M	10	CR25	CARBON
R 1007	4822 110 63207	5,6M	10	CR25	CARBON
R 1008	4822 111 30324	100	5	CR16	CARBON
R 1009	5322 111 30396	22	5	CR16	CARBON
R 1010	5322 116 54619	10K	1	MR25	METAL FILM
R 1013	5322 116 54541	825	1	MR25	METAL FILM
R 1014	5322 116 50506	154	1	MR25	METAL FILM
R 1015	5322 116 54497	226	1	MR25	METAL FILM
R 1018	5322 116 54529	619	1	MR25	METAL FILM
R 1019	4822 111 30348	27	5	CR16	CARBON
R 1020	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1022	5322 111 30074	56	5	CR16	CARBON
R 1023	5322 116 54469	100	1	MR25	METAL FILM
R 1024	5322 111 30074	56	5	CR16	CARBON
R 1025	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1026	5322 116 54469	100	1	MR25	METAL FILM
R 1027	5322 116 54529	619	1	MR25	METAL FILM
R 1028	5322 116 54534	681	1	MR25	METAL FILM
R 1032	5322 111 30288	47K	5	CR16	CARBON
R 1033	4822 111 30348	27	5	CR16	CARBON
R 1035	5322 111 30074	56	5	CR16	CARBON
R 1036	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1037	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1038	5322 111 30074	56	5	CR16	CARBON
R 1039	5322 116 54534	681	1	MR25	METAL FILM
R 1041	5322 116 50561	590	1	MR25	METAL FILM
R 1042	5322 116 54469	100	1	MR25	METAL FILM
R 1043	5322 111 30074	56	5	CR16	CARBON
R 1044	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1045	5322 111 30074	56	5	CR16	CARBON
R 1046	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1047	4822 111 30348	27	5	CR16	CARBON
R 1048	5322 111 30074	56	5	CR16	CARBON
R 1049	5322 116 54469	100	1	MR25	METAL FILM
R 1050	5322 111 30074	56	5	CR16	CARBON
R 1051	5322 116 50561	590	1	MR25	METAL FILM
R 1052	5322 111 30074	56	5	CR16	CARBON
R 1053	5322 116 54534	681	1	MR25	METAL FILM
R 1054	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1055	5322 111 30074	56	5	CR16	CARBON
R 1056	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1057	5322 116 50506	154	1	MR25	METAL FILM
R 1058	4822 111 30348	27	5	CR16	CARBON
R 1079	5322 116 54696	100K	1	MR25	METAL FILM
R 1080	5322 111 30396	22	5	CR16	CARBON
R 1081	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1082	5322 116 54541	825	1	MR25	METAL FILM
R 1083	5322 116 50557	46,4K	1	MR25	METAL FILM
R 1084	5322 116 54011	5,62K	1	MR25	METAL FILM
R 1086	5322 116 54696	100K	1	MR25	METAL FILM
R 1087	5322 116 50515	1,78K	1	MR25	METAL FILM
R 1088	5322 116 50767	2,15K	1	MR25	METAL FILM
R 1089	5322 116 54549	1K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1091	5322 116 54549	1K	1	MR25	METAL FILM
R 1092	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1093	5322 116 54619	10K	1	MR25	METAL FILM
R 1094	5322 116 54549	1K	1	MR25	METAL FILM
R 1096	5322 116 50515	1,78K	1	MR25	METAL FILM
R 1097	5322 116 50767	2,15K	1	MR25	METAL FILM
R 1098	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1099	5322 116 54541	825	1	MR25	METAL FILM
R 1100	5322 111 30396	22	5	CR16	CARBON
R 1101	5322 116 54529	619	1	MR25	METAL FILM
R 1102	5322 116 54536	750	1	MR25	METAL FILM
R 1103	5322 116 54554	1,1K	1	MR25	METAL FILM
R 1104	5322 111 30396	22	5	CR16	CARBON
R 1105	5322 116 50491	22,6	1	MR25	METAL FILM
R 1106	4822 111 30067	33	5	CR16	CARBON
R 1107	5322 116 54529	619	1	MR25	METAL FILM
R 1108	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1109	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1111	5322 116 54549	1K	1	MR25	METAL FILM
R 1112	5322 101 14047	470	20	0,5W	TRIMMING POTM
R 1113	5322 116 54619	10K	1	MR25	METAL FILM
R 1114	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1116	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1117	5322 116 54549	1K	1	MR25	METAL FILM
R 1118	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1119	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1121	5322 116 54529	619	1	MR25	METAL FILM
R 1122	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1123	5322 116 54549	1K	1	MR25	METAL FILM
R 1124	5322 116 54529	619	1	MR25	METAL FILM
R 1125	5322 116 50491	22,6	1	MR25	METAL FILM
R 1126	5322 116 54536	750	1	MR25	METAL FILM
R 1127	5322 111 30396	22	5	CR16	CARBON
R 1128	4822 111 30067	33	5	CR16	CARBON
R 1129	5322 116 54554	1,1K	1	MR25	METAL FILM
R 1131	5322 111 30396	22	5	CR16	CARBON
R 1132	4822 111 30352	82	5	CR16	CARBON
R 1133	5322 111 30396	22	5	CR16	CARBON
R 1134	5322 116 54585	3,48K	1	MR25	METAL FILM
R 1135	4822 111 30347	10	5	CR16	CARBON
R 1136	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1137	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 1138	5322 116 54624	11,5K	1	MR25	METAL FILM
R 1139	5322 116 50515	1,78K	1	MR25	METAL FILM
R 1141	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1142	5322 116 54549	1K	1	MR25	METAL FILM
R 1143	5322 116 54469	100	1	MR25	METAL FILM
R 1144	5322 116 54592	4,02K	1	MR25	METAL FILM
R 1145	5322 111 30365	51	5	CR16	CARBON
R 1146	5322 111 44153	15	5	CR16	CARBON
R 1147	5322 111 44153	15	5	CR16	CARBON
R 1148	5322 116 54515	348	1	MR25	METAL FILM
R 1149	5322 116 54515	348	1	MR25	METAL FILM
R 1150	4822 110 63036	2,2	5	CR25	CARBON
R 1151	5322 111 44153	15	5	CR16	CARBON
R 1152	5322 111 44153	15	5	CR16	CARBON
R 1153	5322 111 30396	22	5	CR16	CARBON
R 1154	5322 111 30396	22	5	CR16	CARBON
R 1155	4822 111 30347	10	5	CR16	CARBON
R 1156	4822 111 30352	82	5	CR16	CARBON
R 1157	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1158	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1159	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1160	5322 116 54469	100	1	MR25	METAL FILM
R 1161	5322 116 54508	301	1	MR25	METAL FILM
R 1162	5322 116 54565	1,62K	1	MR25	METAL FILM
R 1167	4822 110 63036	2,2	5	CR25	CARBON
R 1168	4822 110 63036	2,2	5	CR25	CARBON
R 1169	4822 110 63036	2,2	5	CR25	CARBON
R 1171	4822 110 63036	2,2	5	CR25	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1201	4822 111 30347	10	5	CR16	CARBON
R 1202	5322 116 50904	30,1	1	MR25	METAL FILM
R 1203	5322 116 54508	301	1	MR25	METAL FILM
R 1204	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1205	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1206	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1207	5322 116 54619	10K	1	MR25	METAL FILM
R 1208	5322 116 54617	9,53K	1	MR25	METAL FILM
R 1209	5322 116 54011	5,62K	1	MR25	METAL FILM
R 1211	5322 116 54547	953	1	MR25	METAL FILM
R 1212	5322 116 54442	51,1	1	MR25	METAL FILM
R 1213	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1214	5322 116 54442	51,1	1	MR25	METAL FILM
R 1215	5322 116 54532	649	1	MR25	METAL FILM
R 1216	5322 116 50515	1,78K	1	MR25	METAL FILM
R 1217	5322 116 54442	51,1	1	MR25	METAL FILM
R 1219	5322 116 54442	51,1	1	MR25	METAL FILM
R 1220	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1221	5322 116 54497	226	1	MR25	METAL FILM
R 1222	5322 116 50491	22,6	1	MR25	METAL FILM
R 1223	5322 116 50491	22,6	1	MR25	METAL FILM
R 1224	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1225	5322 116 54009	562	1	MR25	METAL FILM
R 1226	5322 116 54689	82,5K	1	MR25	METAL FILM
R 1227	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1228	4822 111 30067	33	5	CR16	CARBON
R 1229	5322 116 54619	10K	1	MR25	METAL FILM
R 1230	5322 116 50559	27,4K	1	MR25	METAL FILM
R 1231	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1232	5322 116 54608	7,5K	1	MR25	METAL FILM
R 1233	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1234	5322 100 10114	4,7K	20	0.5W	TRIMMING POTM
R 1235	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1236	5322 116 50481	22,6K	1	MR25	METAL FILM
R 1237	5322 116 54009	562	1	MR25	METAL FILM
R 1238	5322 116 50559	27,4K	1	MR25	METAL FILM
R 1239	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1241	5322 116 54009	562	1	MR25	METAL FILM
R 1242	5322 116 50559	27,4K	1	MR25	METAL FILM
R 1243	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1244	5322 116 50491	22,6	1	MR25	METAL FILM
R 1246	5322 116 50491	22,6	1	MR25	METAL FILM
R 1247	4822 111 30245	47	5	CR16	CARBON
R 1248	4822 111 30352	82	5	CR16	CARBON
R 1249	5322 111 30279	33K	5	CR16	CARBON
R 1251	5322 116 54655	30,1K	1	MR25	METAL FILM
R 1252	5322 116 55274	215	1	MR25	METAL FILM
R 1253	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1254	5322 116 50675	2,26K	1	MR25	METAL FILM
R 1256	5322 116 50509	4,87K	1	MR25	METAL FILM
R 1257	5322 116 54562	1,4K	1	MR25	METAL FILM
R 1258	5322 116 50621	536	1	MR25	METAL FILM
R 1259	5322 116 50508	487	1	MR25	METAL FILM
R 1261	5322 116 54576	2,37K	1	MR25	METAL FILM
R 1262	5322 116 54508	301	1	MR25	METAL FILM
R 1263	5322 116 54011	5,62K	1	MR25	METAL FILM
R 1264	5322 116 54567	1,69K	1	MR25	METAL FILM
R 1266	5322 111 30396	22	5	CR16	CARBON
R 1267	5322 116 50482	33,2K	1	MR25	METAL FILM
R 1268	5322 116 54608	7,5K	1	MR25	METAL FILM
R 1269	5322 111 30396	22	5	CR16	CARBON
R 1271	5322 116 50491	22,6	1	MR25	METAL FILM
R 1272	5322 116 54585	3,48K	1	MR25	METAL FILM
R 1273	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1274	5322 116 54009	562	1	MR25	METAL FILM
R 1276	4822 110 63036	2,2	5	CR25	CARBON
R 1277	4822 110 63036	2,2	5	CR25	CARBON
R 1278	4822 110 63036	2,2	5	CR25	CARBON
R 1279	4822 110 63036	2,2	5	CR25	CARBON
R 1280	5322 116 50481	22,6K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1281	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1282	4822 111 30327	220	5	CR16	CARBON
R 1283	4822 111 30331	470	5	CR16	CARBON
R 1284	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1286	5322 116 50556	4,42K	1	MR25	METAL FILM
R 1287	5322 116 54619	10K	1	MR25	METAL FILM
R 1302	5322 116 54901	887K	0,25	MR54C	METAL FILM
R 1303	5322 116 54896	354K	0,25	MR34C	METAL FILM
R 1304	5322 116 54899	176K	0,25	MR34C	METAL FILM
R 1306	5322 116 54897	87,6K	0,25	MR24C	METAL FILM
R 1307	5322 116 54895	34,6K	0,25	MR24C	METAL FILM
R 1308	5322 116 54894	16,8K	0,25	MR24C	METAL FILM
R 1309	5322 116 55161	7,96K	0,25	MR24C	METAL FILM
R 1311	5322 116 50784	2,67K	0,25	MR24C	METAL FILM
R 1312	5322 116 54898	887	0,25	MR24C	METAL FILM
R 1401	5322 100 10113	10K	20	0,5W	TRIMMING POTM
R 1402	5322 116 54696	100K	1	MR25	METAL FILM
R 1403	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1404	5322 116 54515	348	1	MR25	METAL FILM
R 1406	5322 116 54009	562	1	MR25	METAL FILM
R 1407	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1408	5322 116 54516	365	1	MR25	METAL FILM
R 1409	5322 116 50731	10,5K	1	MR25	METAL FILM
R 1411	5322 116 50729	4,22K	1	MR25	METAL FILM
R 1412	5322 116 54446	56,2	1	MR25	METAL FILM
R 1413	5322 116 54012	6,81K	1	MR25	METAL FILM
R 1414	5322 116 54567	1,69K	1	MR25	METAL FILM
R 1416	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1417	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1418	5322 116 54482	133	1	MR25	METAL FILM
R 1419	5322 100 10112	1K	20	0,5W	TRIMMING POTM
R 1420	5322 100 10144	2,2K	20	0.75W	TRIMMING POTM
R 1421	5322 116 54541	825	1	MR25	METAL FILM
R 1422	5322 116 54541	825	1	MR25	METAL FILM
R 1423	5322 116 54525	511	1	MR25	METAL FILM
R 1424	5322 116 54525	511	1	MR25	METAL FILM
R 1425	5322 116 54529	619	1	MR25	METAL FILM
R 1426	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1427	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1428	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1429	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1430	5322 100 10133	220	20	0.75W	TRIMMING POTM
R 1431	5322 116 54619	10K	1	MR25	METAL FILM
R 1432	5322 116 54619	10K	1	MR25	METAL FILM
R 1433	5322 116 50728	1,87K	1	MR25	METAL FILM
R 1434	5322 116 54619	10K	1	MR25	METAL FILM
R 1435	5322 116 54474	110	1	MR25	METAL FILM
R 1436	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1437	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1438	5322 116 54554	1,1K	1	MR25	METAL FILM
R 1439	5322 116 54637	17,8K	1	MR25	METAL FILM
R 1442	5322 111 30396	22	5	CR16	CARBON
R 1444	5322 100 10143	1K	20	0.75W	TRIMMING POTM
R 1445	5322 116 55274	215	1	MR25	METAL FILM
R 1446	5322 116 54506	287	1	MR25	METAL FILM
R 1447	5322 116 50635	1,47K	1	MR25	METAL FILM
R 1448	5322 116 54635	16,9K	1	MR25	METAL FILM
R 1449	5322 116 54643	20,5K	1	MR25	METAL FILM
R 1451	5322 116 54515	348	1	MR25	METAL FILM
R 1452	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1453	5322 116 54608	7,5K	1	MR25	METAL FILM
R 1454	5322 116 54529	619	1	MR25	METAL FILM
R 1456	5322 116 54506	287	1	MR25	METAL FILM
R 1457	5322 116 54619	10K	1	MR25	METAL FILM
R 1458	5322 116 54565	1,62K	1	MR25	METAL FILM
R 1459	5322 116 55277	9,09K	1	MR25	METAL FILM
R 1461	5322 116 50579	3,16K	1	MR25	METAL FILM
R 1462	5322 100 10141	10K	20	0.75W	TRIMMING POTM
R 1463	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1466	5322 116 54619	10K	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1467	5322 111 30396	22	5	CR16	CARBON
R 1468	5322 116 50509	4,87K	1	MR25	METAL FILM
R 1470	5322 116 54519	402	1	MR25	METAL FILM
R 1471	5322 116 54529	619	1	MR25	METAL FILM
R 1472	5322 116 54576	2,37K	1	MR25	METAL FILM
R 1473	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1474	5322 111 30356	43	5	CR16	CARBON
R 1476	5322 116 54442	51,1	1	MR25	METAL FILM
R 1477	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1478	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1480	5322 116 54571	1,96K	1	MR25	METAL FILM
R 1481	5322 116 54508	301	1	MR25	METAL FILM
R 1482	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1483	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1484	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1486	5322 116 54508	301	1	MR25	METAL FILM
R 1487	5322 116 54565	1,62K	1	MR25	METAL FILM
R 1488	5322 116 54011	5,62K	1	MR25	METAL FILM
R 1489	5322 111 30356	43	5	CR16	CARBON
R 1490	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1491	5322 116 50524	3,01K	1	MR25	METAL FILM
R 1493	4822 111 30324	100	5	CR16	CARBON
R 1494	5322 116 54442	51,1	1	MR25	METAL FILM
R 1495	5322 116 54538	787	1	MR25	METAL FILM
R 1496	5322 116 54508	301	1	MR25	METAL FILM
R 1497	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1498	5322 100 10114	4,7K	20	0.5W	TRIMMING POTM
R 1499	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1501	5322 116 50559	27,4K	1	MR25	METAL FILM
R 1502	5322 116 50583	5,9K	1	MR25	METAL FILM
R 1513	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 1514	5322 101 14069	22K	20	0.5W	TRIMMING POTM
R 1600	5322 116 54005	3,32K	1	MR25	METAL FILM
R 1601	5322 116 50491	22,6	1	MR25	METAL FILM
R 1602	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1603	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1604	5322 116 54519	402	1	MR25	METAL FILM
R 1605	5322 116 54466	90,9	1	MR25	METAL FILM
R 1606	5322 116 54466	90,9	1	MR25	METAL FILM
R 1607	5322 116 54489	169	1	MR25	METAL FILM
R 1608	5322 116 54567	1,69K	1	MR25	METAL FILM
R 1609	5322 116 54567	1,69K	1	MR25	METAL FILM
R 1610	5322 116 50484	4,64K	1	MR25	METAL FILM
R 1611	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1612	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1613	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1614	5322 116 50636	2,74K	1	MR25	METAL FILM
R 1616	5322 116 54529	619	1	MR25	METAL FILM
R 1617	5322 116 54619	10K	1	MR25	METAL FILM
R 1626	5322 116 54595	5,11K	1	MR25	METAL FILM
R 1627	5322 116 54587	3,65K	1	MR25	METAL FILM
R 1628	5322 111 44164	4,3	5	CR25	CARBON
R 1629	5322 116 50593	16,2K	1	MR25	METAL FILM
R 1630	5322 116 54455	68,1	1	MR25	METAL FILM
R 1631	5322 116 54606	7,15K	1	MR25	METAL FILM
R 1632	5322 116 54606	7,15K	1	MR25	METAL FILM
R 1633	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1634	4822 111 30269	1K	5	CR16	CARBON
R 1636	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1637	5322 116 54587	3,65K	1	MR25	METAL FILM
R 1638	5322 116 54455	68,1	1	MR25	METAL FILM
R 1642	5322 111 44164	4,3	5	CR25	CARBON
R 1701	5322 116 54696	100K	1	MR25	METAL FILM
R 1702	4822 111 30245	47	5	CR16	CARBON
R 1703	5322 116 54009	562	1	MR25	METAL FILM
R 1704	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1705	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1706	5322 111 30396	22	5	CR16	CARBON
R 1707	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1708	5322 111 30396	22	5	CR16	CARBON

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1709	5322 116 54549	1K	1	MR25	METAL FILM
R 1711	4822 110 63174	330K	5	CR25	CARBON
R 1712	5322 111 30356	43	5	CR16	CARBON
R 1713	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1714	5322 111 30356	43	5	CR16	CARBON
R 1716	5322 116 54557	1,21K	1	MR25	METAL FILM
R 1717	5322 116 50509	4,87K	1	MR25	METAL FILM
R 1718	5322 116 54587	3,65K	1	MR25	METAL FILM
R 1719	5322 116 50572	12,1K	1	MR25	METAL FILM
R 1721	5322 111 30396	22	5	CR16	CARBON
R 1722	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1723	5322 116 54549	1K	1	MR25	METAL FILM
R 1724	4822 110 63165	150K	5	CR25	CARBON
R 1726	5322 116 50479	15,4K	1	MR25	METAL FILM
R 1727	5322 111 30396	22	5	CR16	CARBON
R 1728	5322 116 54696	100K	1	MR25	METAL FILM
R 1729	4822 111 30245	47	5	CR16	CARBON
R 1730	5322 116 50558	18,7K	1	MR25	METAL FILM
R 1731	5322 116 54009	562	1	MR25	METAL FILM
R 1732	4822 110 63036	2,2	5	CR25	CARBON
R 1733	4822 110 63036	2,2	5	CR25	CARBON
R 1803	5322 116 54743	301K	1	MR25	METAL FILM
R 1804	5322 116 54743	301K	1	MR25	METAL FILM
R 1805	5322 116 55149	24,9K	1	MR30	METAL FILM
R 1806	4822 110 63214	10M	10	CR25	CARBON
R 1807	4822 110 63196	2,2M	10	CR25	CARBON
R 1808	5322 116 54426	121	1	MR25	METAL FILM
R 1809	5322 116 54549	1K	1	MR25	METAL FILM
R 1810	5322 116 50557	46,4K	1	MR25	METAL FILM
R 1811	4822 112 21054	10	5	4.2W	WIRE-WOUND
R 1812	5322 116 54549	1K	1	MR25	METAL FILM
R 1813	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1814	5322 111 44195	10	5	0.5W	CARBON
R 1815	5322 116 34028	150K	5	0.5W	NTC
R 1817	5322 116 50442	48,7K	1	MR25	METAL FILM
R 1818	5322 116 54965	82	5	PR52	METAL FILM
R 1819	5322 116 54619	10K	1	MR25	METAL FILM
R 1820	5322 116 54549	1K	1	MR25	METAL FILM
R 1821	5322 116 54549	1K	1	MR25	METAL FILM
R 1822	5322 116 50731	10,5K	1	MR25	METAL FILM
R 1823	5322 116 54529	619	1	MR25	METAL FILM
R 1824	5322 116 54549	1K	1	MR25	METAL FILM
R 1825	5322 116 54469	100	1	MR25	METAL FILM
R 1826	5322 116 54574	2,21K	1	MR25	METAL FILM
R 1827	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1828	5322 100 10115	1K	20	0,5W	TRIMMING POTM
R 1829	5322 116 50586	1,54K	1	MR25	METAL FILM
R 1830	5322 116 50669	205	1	MR25	METAL FILM
R 1831	5322 116 54558	8,25K	1	MR25	METAL FILM
R 1832	5322 116 50664	2,05K	1	MR25	METAL FILM
R 1833	5322 116 54906	75	1	MR30	METAL FILM
R 1834	5322 116 54619	10K	1	MR25	METAL FILM
R 1835	5322 116 54014	23,7	1	MR25	METAL FILM
R 1836	5322 116 50559	27,4K	1	MR25	METAL FILM
R 1837	5322 116 54696	100K	1	MR25	METAL FILM
R 1838	4822 110 63187	1M	5	CR25	CARBON
R 1839	5322 116 54648	24,9K	1	MR25	METAL FILM
R 1840	5322 116 54192	5,1	5	CR25	METAL FILM
R 1841	5322 116 54469	100	1	MR25	METAL FILM
R 1842	5322 116 54469	100	1	MR25	METAL FILM
R 1843	5322 116 54738	274K	1	MR25	METAL FILM
R 1844	5322 116 54619	10K	1	MR25	METAL FILM
R 1845	4822 110 63058	15	5	CR25	CARBON
R 1846	5322 116 54696	100K	1	MR25	METAL FILM
R 1847	5322 116 54696	100K	1	MR25	METAL FILM
R 1848	5322 116 54525	511	1	MR25	METAL FILM
R 1849	5322 116 55097	47	5	PR37	METAL FILM
R 1851	5322 116 34039	22	20	0.5W	NTC
R 1852	5322 116 54069	12,1	1	MR25	METAL FILM
R 1853	5322 116 54069	12,1	1	MR25	METAL FILM

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
R 1857	5322 116 54696	100K	1	MR25	METAL FILM
R 1858	5322 116 50904	30,1	1	MR25	METAL FILM
R 1901	5322 116 54469	100	1	MR25	METAL FILM
R 1902	5322 116 54641	19,6K	1	MR25	METAL FILM
R 1903	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1904	5322 116 54525	511	1	MR25	METAL FILM
R 1906	5322 100 10114	4,7K	20	0.5W	TRIMMING POTM
R 1907	5322 116 54538	787	1	MR25	METAL FILM
R 1908	5322 116 50415	1,15K	1	MR25	METAL FILM
R 1909	5322 116 50608	6,19K	1	MR25	METAL FILM
R 1911	5322 116 54524	499	1	MR25	METAL FILM
R 1912	5322 116 54469	100	1	MR25	METAL FILM
R 2001	5322 116 54497	226	1	MR25	METAL FILM
R 2002	4822 110 42187	1M	5	VR37	CARBON
R 2003	4822 110 42189	1,2M	5	VR37	CARBON
R 2004	5322 116 54619	10K	1	MR25	METAL FILM
R 2006	5322 116 54565	1,62K	1	MR25	METAL FILM
R 2007	5322 116 54469	100	1	MR25	METAL FILM
R 2008	5322 116 50592	442	1	MR25	METAL FILM
R 2009	5322 116 54462	82,5	1	MR25	METAL FILM
R 2010	5322 116 54657	31,6K	1	MR25	METAL FILM
R 2011	5322 116 54543	866	1	MR25	METAL FILM
R 2012	5322 116 54683	68,1K	1	MR25	METAL FILM
R 2013	5322 116 50636	2,74K	1	MR25	METAL FILM
R 2016	4822 110 63178	470K	5	CR25	CARBON
R 2024	4822 110 42214	10M	5	VR37	CARBON

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
DIODES		
GR1	5322 130 34595	CQY24A-I
GR2	5322 130 34595	CQY24A-I
GR3	5322 130 34595	CQY24A-I
GR101	5322 130 34037	BAV45
GR102	5322 130 30283	AAZ17
GR301	4822 130 30613	BAW62
GR302	5322 130 34049	BZX75-C2V1
GR303	5322 130 30644	BA182
GR304	5322 130 30644	BA182
GR311	4822 130 30861	BZX79-C7V5
GR351	4822 130 30613	BAW62
GR352	5322 130 34049	BZX75-C2V1
GR353	5322 130 30644	BA182
GR354	5322 130 30644	BA182
GR356	4822 130 34233	BZX79-B5V1
GR357	4822 130 34233	BZX79-B5V1
GR401	5322 130 34049	BZX75-C2V1
GR402	4822 130 34174	BZX79-C4V7
GR403	4822 130 30613	BAW62
GR404	4822 130 34278	BZX79-C6V8
GR406	4822 130 30613	BAW62
GR407	5322 130 34511	GESELECTEERD
GR408	4822 130 30613	BAW62
GR409	4822 130 30613	BAW62
GR502	4822 130 34173	BZX79-C5V6
GR503	4822 130 34233	BZX79-C5V1
GR505	4822 130 30613	BAW62
GR506	4822 130 30613	BAW62
GR507	4822 130 34173	BZX79-C5V6
GR508	5322 130 30605	BAX17
GR509	5322 130 30605	BAX17
GR510	5322 130 30605	BAX17
GR511	5322 130 30605	BAX17

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
GR512	5322 130 30605	BAX17
GR513	4822 130 34383	BZX79-C47
GR514	5322 130 30605	BAX17
GR515	5322 130 30605	BAX17
GR516	5322 130 30605	BAX17
GR517	5322 130 30605	BAX17
GR518	5322 130 30605	BAX17
GR519	5322 130 34605	BAX12
GR521	4822 130 34167	BZX79-C6V2
GR522	5322 130 34605	BAX12
GR600	5322 130 34337	BAV99
GR601	5322 130 34337	BAV99
GR602	5322 130 34331	BAV70
GR603	4822 130 30613	BAW62
GR604	4822 130 30613	BAW62
GR606	5322 130 30765	BZX75-C3V6
GR801	4822 130 30613	BAW62
GR802	4822 130 30613	BAW62
GR803	4822 130 30613	BAW62
GR804	4822 130 30613	BAW62
GR807	4822 130 30613	BAW62
GR808	4822 130 30613	BAW62
GR809	4822 130 30613	BAW62
GR1000	5322 130 34337	BAV99
GR1001	5322 130 34337	BAV99
GR1002	5322 130 34331	BAV70
GR1003	4822 130 30613	BAW62
GR1004	4822 130 30613	BAW62
GR1006	5322 130 30765	BZX75-C3V6
GR1201	4822 130 30613	BAW62
GR1202	4822 130 30613	BAW62
GR1203	4822 130 30613	BAW62
GR1204	4822 130 30613	BAW62
GR1206	4822 130 30613	BAW62
GR1207	4822 130 30613	BAW62
GR1401	4822 130 30613	BAW62
GR1402	4822 130 30613	BAW62
GR1403	4822 130 30613	BAW62
GR1404	4822 130 30613	BAW62
GR1406	4822 130 30613	BAW62
GR1407	4822 130 30613	BAW62
GR1408	4822 130 30613	BAW62
GR1601	5322 130 34605	BAX12
GR1620	4822 130 34197	BZX79-C12
GR1701	4822 130 34233	BZX79-C5V1
GR1702	5322 130 34328	BZX79-B30
GR1703	4822 130 34173	BZX79-B5V6
GR1704	5322 130 34145	BZX79-B39
GR1706	5322 130 34329	BZX79-B43
GR1707	4822 130 34233	BZX79-C5V1
GR1801	4822 130 30817	BYX55-600
GR1802	4822 130 30817	BYX55-600
GR1803	4822 130 30817	BYX55-600
GR1804	4822 130 30817	BYX55-600
GR1806	4822 130 30839	BY206
GR1807	4822 130 30839	BY206
GR1809	4822 130 20039	BR100-03
GR1810	5322 130 34605	BAX12
GR1811	4822 130 30817	BYX55-600
GR1812	5322 130 34297	BZX79-C10
GR1813	5322 130 34034	BZX61-C75
GR1814	5322 130 30565	BZX61-C47
GR1815	4822 130 34233	BZX79-C5V1
GR1816	4822 130 30817	BYX55-600
GR1818	4822 130 30613	BAW62
GR1819	5322 130 34048	BZX75-C2V8
GR1820	4822 130 30613	BAW62
GR1821	4822 130 30839	BY206
GR1822	4822 130 30839	BY206
GR1823	4822 130 30613	BAW62

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
GR1824	4822 130 30839	BY206
GR1825	5322 130 34605	BAX12
GR1826	4822 130 30839	BY206
GR1827	4822 130 30839	BY206
GR1828	4822 130 30613	BAW62
GR1831	4822 130 30839	BY206 Rect 500V PRI
GR1832	4822 130 30839	BY206
GR1833	4822 130 30839	BY206
GR1834	4822 130 30839	BY206
GR1836	4822 130 30839	BY206
GR1837	4822 130 30839	BY206
GR1842	4822 130 30839	BY206
GR1843	4822 130 30839	BY206
GR1844	4822 130 30839	BY206
GR1846	4822 130 30839	BY206
GR1847	4822 130 30817	BYX55-600
GR1848	4822 130 30839	BY206
GR1849	4822 130 30839	BY206
GR1851	4822 130 30817	BYX55-600
GR1901	4822 130 34173	BZX79-C5V6
GR2001	5322 130 34594	BY409
GR2002	5322 130 34605	BAX12
GR2003	4822 130 30839	BY206
GR2004	4822 130 30613	BAW62
GR2005	5322 130 34605	BAX12
GR2013	5322 130 34594	BY409
GR2014	5322 130 34594	BY409
GR2016	5322 130 34594	BY409
GR2017	5322 130 34594	BY409
GR2018	5322 130 34594	BY409
GR2019	5322 130 34594	BY409
GR2021	5322 130 34594	BY409
GR2022	5322 130 34594	BY409
GR2023	5322 130 34594	BY409

TRANSISTORS

TS101	5322 130 44605	ON471
TS102	5322 130 44459	BFT25R
TS103	5322 130 44606	BFR92R
TS200	4822 130 40941	BC558
TS205	4822 130 40938	BC548
TS301	4822 130 40941	BC558
TS302	4822 130 40941	BC558
TS303	4822 130 40941	BC558
TS304	4822 130 40938	BC548
TS306	4822 130 40938	BC548
TS311	4822 130 40938	BC548
TS351	4822 130 40941	BC558
TS352	4822 130 40941	BC558
TS353	4822 130 40941	BC558
TS354	4822 130 40938	BC548
TS356	4822 130 40938	BC548
TS401	5322 130 44618	BFR94R
TS402	5322 130 44618	BFR94R
TS503	4822 130 40938	BC548
TS504	5322 130 44396	BF324
TS506	5322 130 40672	BFW44
TS507	4822 130 40908	BF336
TS508	4822 130 40908	BF336
TS509	5322 130 40493	BFY90
TS511	4822 130 40941	BC558
TS512	4822 130 40968	BSS38
TS513	4822 130 40941	BC558

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
TS514	4822 130 40968	BSS38
TS516	4822 130 40938	BC548
TS518	4822 130 40968	BSS38
TS519	4822 130 40941	BC558
TS521	4822 130 40938	BC548
TS522	4822 130 40941	BC558
TS523	4822 130 40938	BC548
TS524	4822 130 40941	BC558
TS526	4822 130 40938	BC548
TS527	4822 130 40645	BD135
TS528	4822 130 40712	BD136
TS601	5322 130 44361	ON475
TS602	5322 130 44337	BCW33
TS603	5322 130 44338	BFS17R
TS604	5322 130 44662	GESELECTEERD
TS607	5322 130 44338	BFS17R
TS608	5322 130 44663	GESELECTEERD
TS609	5322 130 44342	BCW33R
TS611	5322 130 44338	BFS17R
TS612	5322 130 44342	BCW33R
TS613	5322 130 40781	BFS17
TS614	5322 130 40781	BFS17
TS616	5322 130 44342	BCW33R
TS617	5322 130 44338	BFS17R
TS618	5322 130 40781	BFS17
TS623	5322 130 44337	BCW33
TS624	5322 130 44342	BCW33R
TS626	5322 130 44337	BCW33
TS627	5322 130 44338	BFS17R
TS628	5322 130 44335	BCW30
TS629	5322 130 44335	BCW30
TS631	5322 130 44341	BCW30R
TS632	5322 130 44341	BCW30R
TS633	5322 130 40781	BFS17
TS634	5322 130 44337	BCW33
TS636	5322 130 44337	BCW33
TS637	5322 130 44335	BCW30
TS638	5322 130 44335	BCW30
TS639	5322 130 44341	BCW30R
TS641	5322 130 44342	BCW33R
TS642	5322 130 44342	BCW33R
TS643	5322 130 44338	BFS17R
TS644	5322 130 44662	GESELECTEERD
TS646	5322 130 40781	BFS17
TS647	5322 130 44663	GESELECTEERD
TS648	5322 130 44356	537BSY-R
TS649	5322 130 44338	BFS17R
TS801	5322 130 40781	BFS17
TS802	5322 130 40781	BFS17
TS803	5322 130 40781	BFS17
TS804	5322 130 40781	BFS17
TS805	5322 130 44342	BCW33R
TS806	5322 130 44335	BCW30
TS807	5322 130 44336	BSV52
TS808	5322 130 44336	BSV52
TS809	5322 130 44342	BCW33R
TS811	5322 130 44337	BCW33
TS812	5322 130 44342	BCW33R
TS813	5322 130 44342	BCW33R
TS814	5322 130 44338	BFS17R
TS815	5322 130 44339	BFS19R
TS816	5322 130 44359	537BSY
TS817	5322 130 44359	537BSY
TS818	5322 130 44356	537BSY-R
TS819	5322 130 44339	BFS19R
TS820	5322 130 44339	BFS19R
TS821	5322 130 44339	BFS19R
TS822	5322 130 44339	BFS19R
TS823	5322 130 44339	BFS19R
TS824	5322 130 44342	BCW33R
TS825	5322 130 44337	BCW33
TS826	5322 130 44337	BCW33
TS827	5322 130 30187	BCY88
TS829	5322 130 44342	BCW33R
TS831	5322 130 44342	BCW33R

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
TS1001	5322 130 44361	ON475
TS1003	5322 130 40781	BFS17
TS1004	5322 130 44338	BFS17R
TS1007	5322 130 40781	BFS17
TS1008	5322 130 40781	BFS17
TS1011	5322 130 40781	BFS17
TS1012	5322 130 44337	BCW33
TS1013	5322 130 44338	BFS17R
TS1014	5322 130 44338	BFS17R
TS1016	5322 130 44337	BCW33
TS1017	5322 130 40781	BFS17
TS1018	5322 130 44338	BFS17R
TS1027	5322 130 44338	BFS17R
TS1028	5322 130 44341	BCW30R
TS1029	5322 130 44335	BCW30
TS1031	5322 130 44341	BCW30R
TS1032	5322 130 44341	BCW30R
TS1033	5322 130 40781	BFS17
TS1034	5322 130 44337	BCW33
TS1036	5322 130 44342	BCW33R
TS1037	5322 130 44335	BCW30
TS1038	5322 130 44335	BCW30
TS1039	5322 130 44341	BCW30R
TS1041	5322 130 44342	BCW33R
TS1042	5322 130 44342	BCW33R
TS1043	5322 130 44338	BFS17R
TS1044	5322 130 40781	BFS17
TS1046	5322 130 40781	BFS17
TS1047	5322 130 44338	BFS17R
TS1201	5322 130 40781	BFS17
TS1202	5322 130 40781	BFS17
TS1203	5322 130 40781	BFS17
TS1204	5322 130 40781	BFS17
TS1206	5322 130 44335	BCW30
TS1207	5322 130 44336	BSV52
TS1208	5322 130 44336	BSV52
TS1209	5322 130 44337	BCW33
TS1210	5322 130 44339	BFS19R
TS1211	5322 130 44342	BCW33R
TS1212	5322 130 44339	BFS19R
TS1213	5322 130 44339	BFS19R
TS1214	5322 130 44337	BCW33
TS1216	5322 130 44337	BCW33
TS1217	5322 130 40781	BFS17
TS1218	5322 130 44359	537BSY
TS1219	5322 130 44359	537BSY
TS1221	5322 130 44359	537BSY
TS1222	5322 130 44356	537BSY-R
TS1223	5322 130 44356	537BSY-R
TS1224	5322 130 44342	BCW33R
TS1226	5322 130 30187	BCY88
TS1227	5322 130 44337	BCW33
TS1400	4822 130 44197	BC558B
TS1401	4822 130 44197	BC558B
TS1402	4822 130 40938	BC548
TS1403	5322 130 44093	BSV78
TS1404	5322 130 44337	BCW33
TS1405	4822 130 40938	BC548
TS1406	5322 130 44337	BCW33
TS1407	5322 130 44342	BCW33R
TS1408	5322 130 44337	BCW33
TS1409	5322 130 44337	BCW33
TS1411	5322 130 44335	BCW30
TS1412	5322 130 44337	BCW33
TS1413	5322 130 44342	BCW33R
TS1414	5322 130 44337	BCW33
TS1416	5322 130 44337	BCW33
TS1417	5322 130 44342	BCW33R
TS1418	5322 130 44337	BCW33
TS1419	5322 130 44335	BCW30
TS1421	5322 130 44335	BCW30
TS1422	5322 130 44335	BCW30
TS1423	5322 130 44335	BCW30
TS1424	5322 130 44335	BCW30
TS1426	5322 130 44335	BCW30

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
TS1601	5322 130 40417	BSX20
TS1602	5322 130 40417	BSX20
TS1603	4822 130 40941	BC558
TS1604	5322 130 40417	BSX20
TS1611	4822 130 40941	BC558
TS1612	4822 130 40941	BC558
TS1613	4822 130 44197	BC558B
TS1615	5322 130 44357	BD262
TS1701	5322 130 40672	BFW44
TS1702	4822 130 40908	BF336
TS1703	5322 130 40417	BSX20
TS1704	5322 130 44396	BF324
TS1706	5322 130 44396	BF324
TS1707	5322 130 44127	2N2894A
TS1708	5322 130 40672	BFW44
TS1709	4822 130 40908	BF336
TS1801	5322 130 44457	BDY93-01
TS1802	5322 130 24009	BTX18-500
TS1803	5322 130 44406	
TS1806	5322 130 44019	BSX60
TS1807	4822 130 44246	BC549C
TS1808	5322 130 40482	BRY39
TS1809	5322 130 44395	CNY43
TS1811	4822 130 40963	BC559
TS1812	4822 130 44246	BC549C
TS1813	4822 130 44246	BC549C
TS2001	5322 130 44462	BC556A
TS2002	4822 130 40959	BC547B
TS2003	4822 130 44461	BC546B
TS2004	5322 130 40714	BSW68

ITEM	ORDERING NUMBER	OHM	TOL (%)	TYPE	REMARKS
INTEGRATED CIRCUITS					
IC101	5322 209 85475	LM208T			
IC102	5322 111 94032	TF CIRC	UIT		WIRE-WOUND
IC301	5322 209 84427	TF CIRCUIT			
IC302	5322 209 84425	TF CIRCUIT			
IC303	5322 209 84342	LM741CH			
IC304	5322 209 84426	TF CIRCUIT			
IC306	5322 209 84428	TF CIRCUIT			
IC351	5322 209 84427	TF CIRCUIT			
IC352	5322 209 84425	TF CIRCUIT			
IC353	5322 209 84342	LM741CH			
IC354	5322 209 84426	TF CIRCUIT			
IC401	5322 209 84483	TF CIRCUIT			
IC402	5322 209 84484	TF CIRCUIT			
IC403	5322 209 84484	TF CIRCUIT			
IC601	5322 209 84485	TF CIRCUIT			
IC1001	5322 209 84485	TF CIRCUIT			
IC1601	5322 209 84528	N7400N	IN		
IC1602	5322 209 84512	N7426N	SC		
IC1603	5322 209 84166	N7472N	SC		
IC1614	5322 209 84899	LM723CH			
IC1801	5322 209 84899	UA723CK	SC		
IC1901	5322 209 84452	709HC			
COILS					
L 1	5322 157 44035	SAM SPOEL			
L 391	5322 281 64154	COIL			
L 411	5322 158 14121	L-R COMBINATIE			
L 412	5322 158 14121	L-R COMBINATIE			
L 501	5322 150 14013	ESB CORR COIL			

ITEM	ORDERING NUMBER	TYPE/DESCRIPTION
L 1601	5322 281 64154	COIL
L 1800	5322 156 14076	SPOEL
L 1801	5322 158 14171	SAM TRAFO
L 1802	5322 158 14171	SAM TRAFO
L 1803	5322 156 14076	SPOEL
L 1804	5322 158 34068	SMOORSPOEL
L 1805	5322 156 14076	SPOEL
L 1806	5322 156 14076	SPOEL
L 1807	5322 156 44014	COIL
L 1809	5322 156 44014	COIL
L 1812	5322 156 44014	COIL
L 1814	5322 156 44014	COIL
L 1817	5322 156 44014	COIL
L 1819	5322 156 44014	COIL
L 1822	5322 156 44014	COIL
L 2001	5322 281 64154	COIL
L 2002	5322 158 14034	MICROCHOKE
L 2003	5322 158 14034	MICROCHOKE
MISCELLANEOUS		
LA1	5322 134 44123	
LA2	5322 134 44123	
RE101	5322 280 24076	RELAY COIL
RE102	5322 280 24076	RELAY COIL
RE103	5322 280 24076	RELAY COIL
RE104	5322 280 24076	RELAY COIL
RE106	5322 280 24076	RELAY COIL
RE107	5322 280 24076	RELAY COIL
RE108	5322 280 24076	RELAY COIL
RE109	5322 280 24076	RELAY COIL
RE111	5322 280 24076	RELAY COIL
RE112	5322 280 24076	RELAY COIL
	5322 218 64046	Transistor BSR 12R,replacement for type BFS 17R
	5322 130 44778	
	5322 130 44743	Transistor BSR 12,replacement for type BFS 17

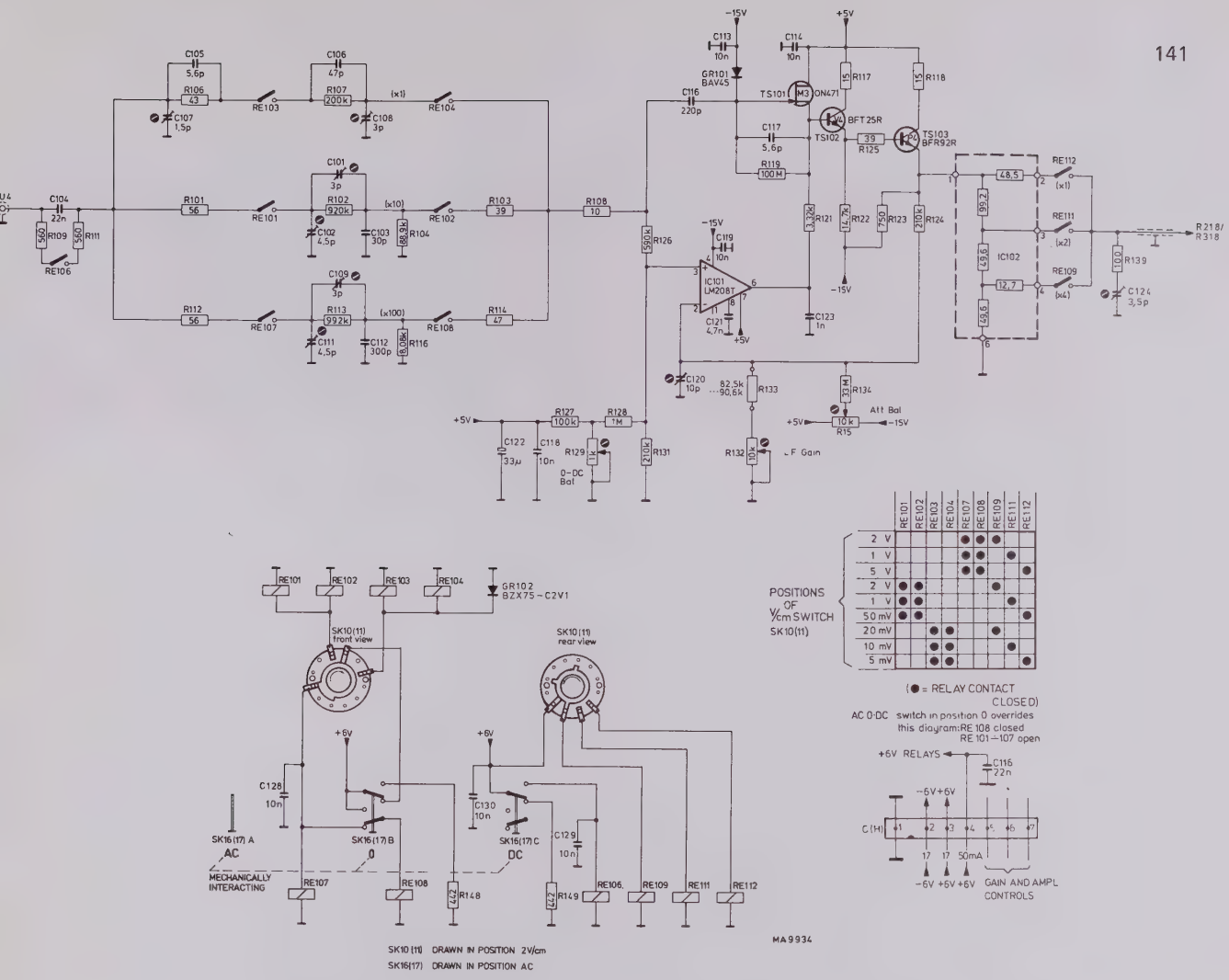


Fig. 3.32. Y Attenuator circuit diagram

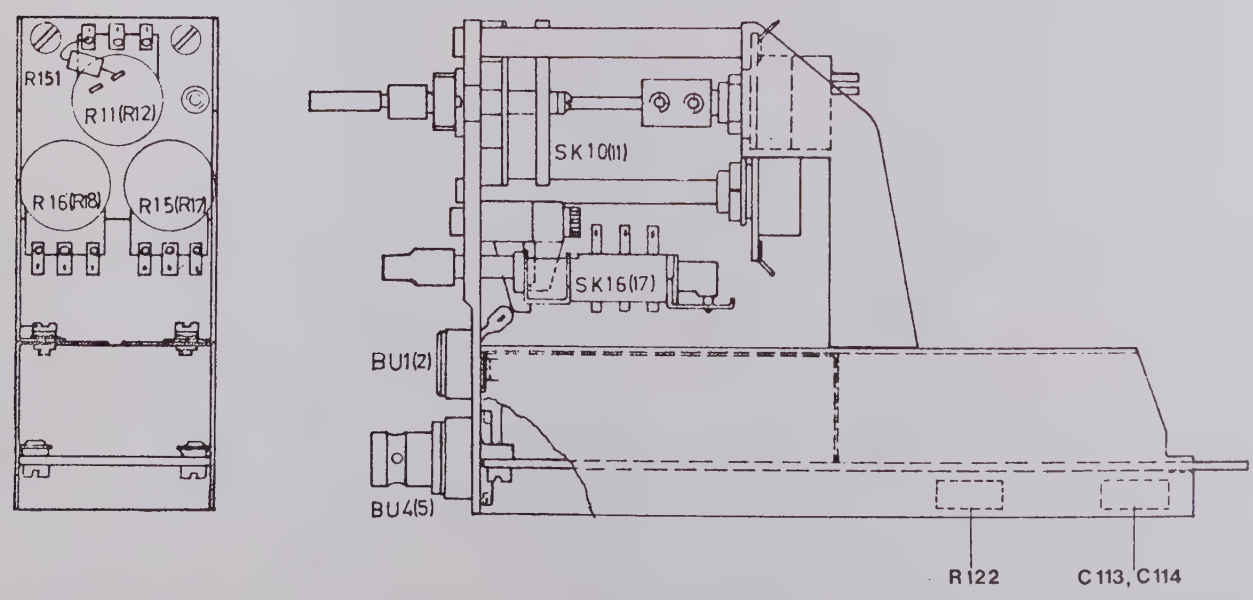


Fig. 3.33. Y Attenuator assembly

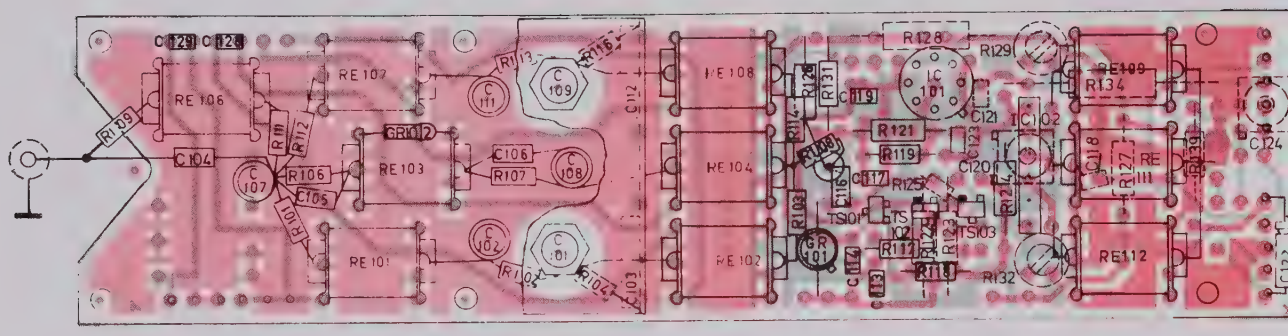


Fig. 3.34. Y Attenuator circuit board

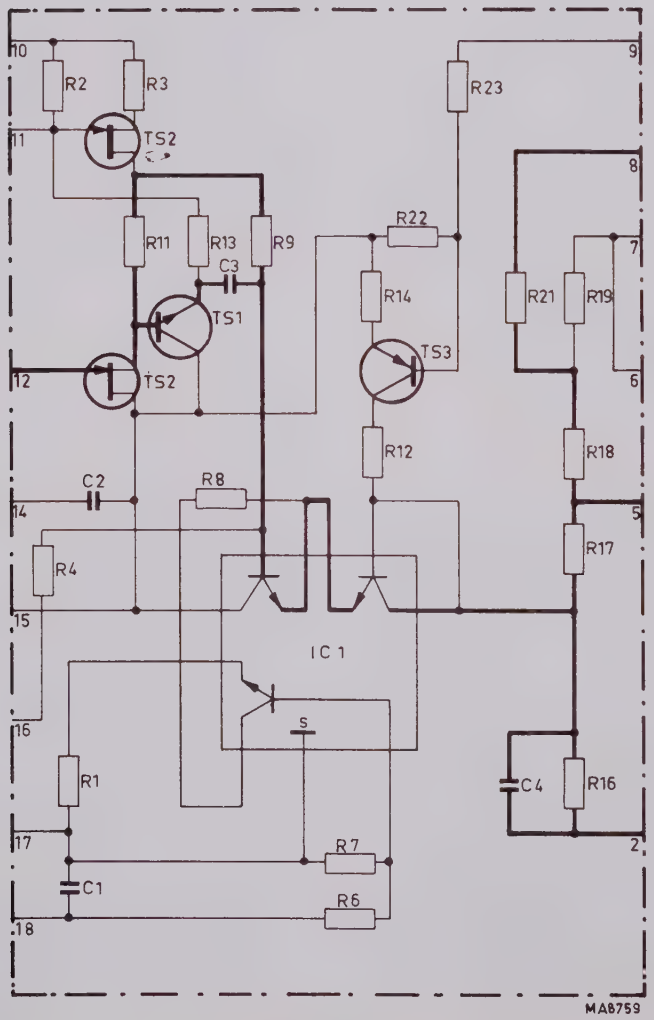


Fig. 3.35. Circuit diagram impedance converter (hybrid circuit)

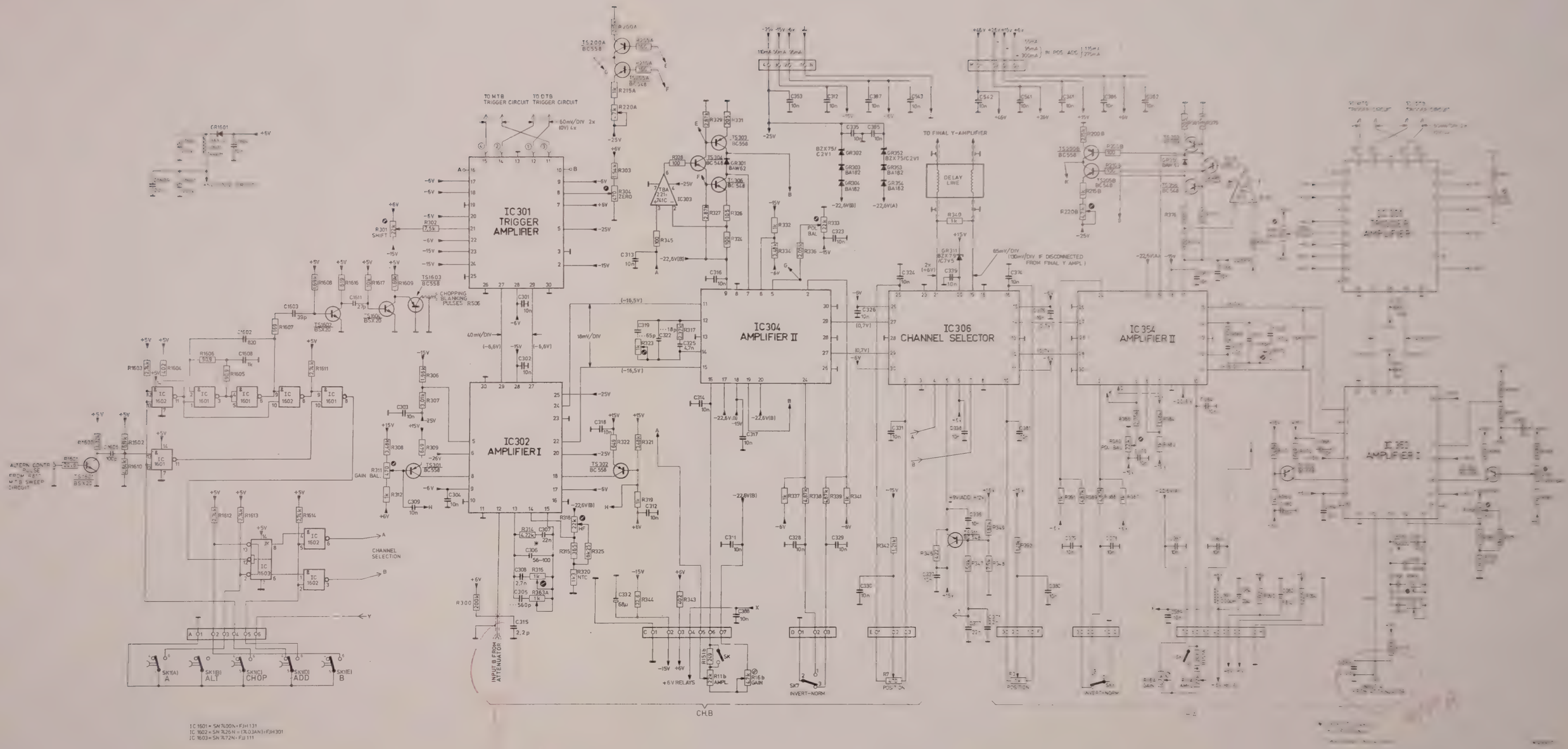


Fig. 3.36. Intermediate Y amplifier circuit diagram

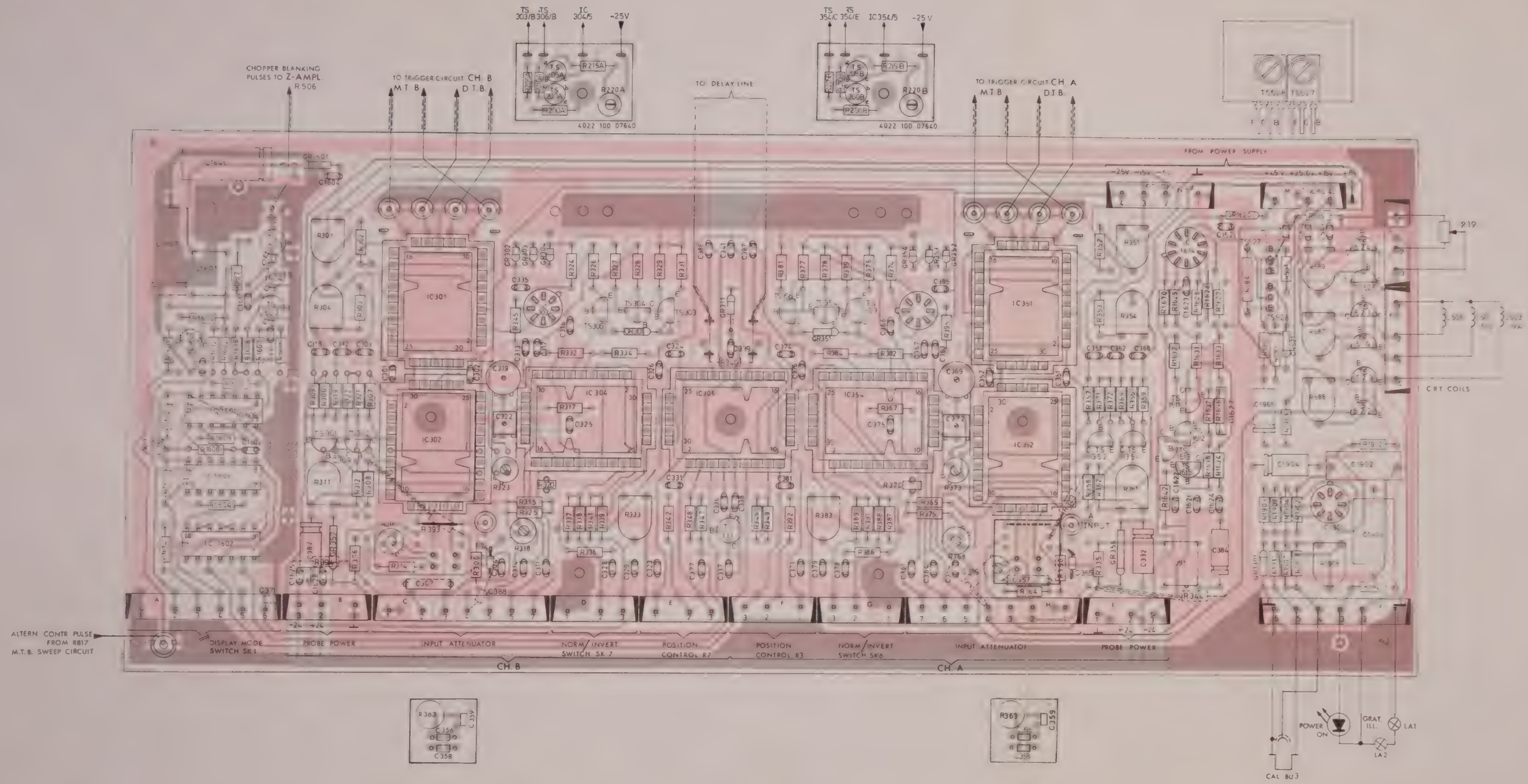


Fig. 3.37. Intermediate Y amplifier circuit board

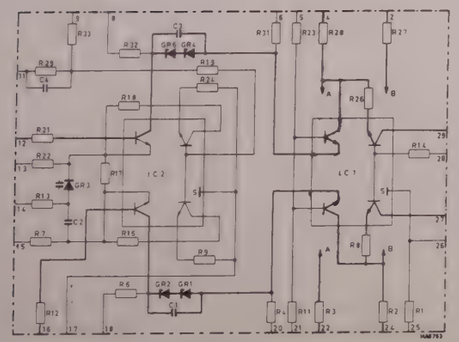


Fig. 3.38. Circuit diagram amplifier I (hybrid circuit)

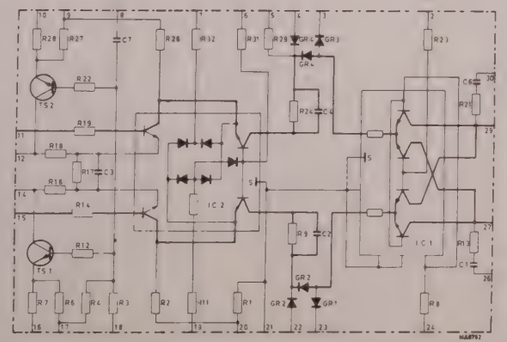


Fig. 3.39. Circuit diagram amplifier II (hybrid circuit)

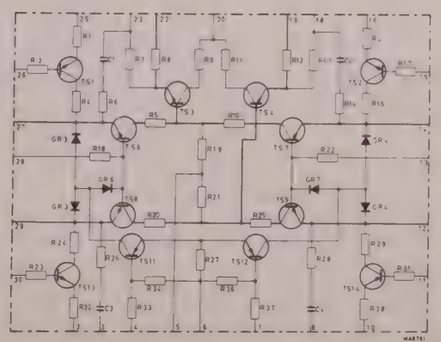


Fig. 3.40. Circuit diagram channel selector (hybrid circuit)

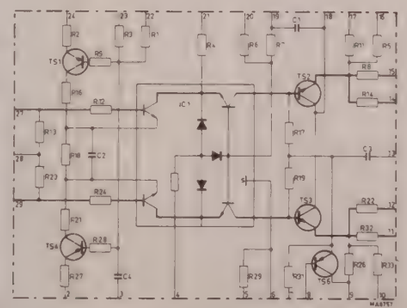


Fig. 3.41. Circuit diagram trigger amplifier (hybrid circuit)

IC 401

DELAY LINE COMPENSATION AMPLIFIER

IC 402

FINAL AMPLIFIER

IC 403

FINAL AMPLIFIER

+13,6V

+10,3V

+6V

+9,3V

+15V(A)

* SELECTED PARTS H.F RESPONSE (DELAY LINE COMPENSATION)

GR407 selected to 3,3V ± 3% at 5mA

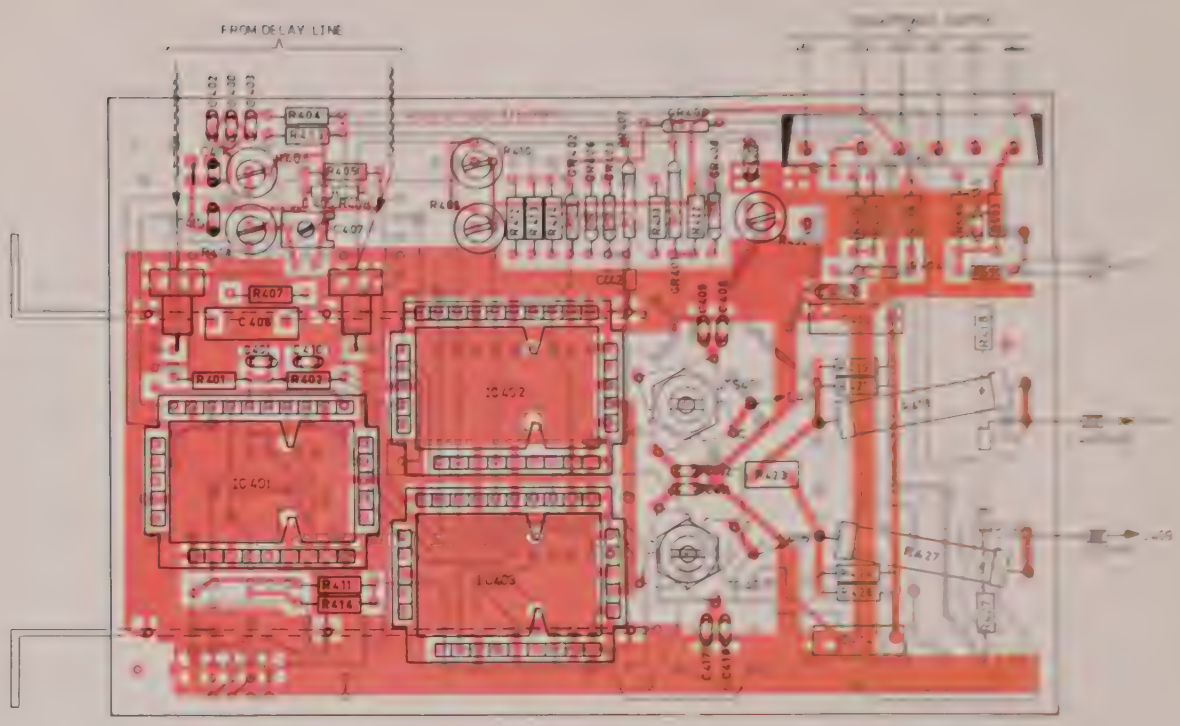


Fig. 3.43. Final Y amplifier circuit board

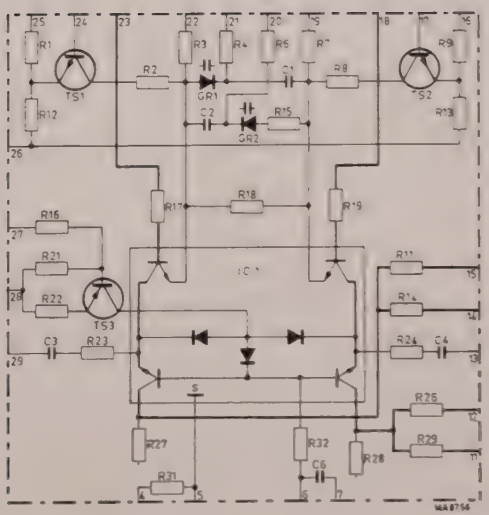


Fig. 3.44. Circuit diagram delay-line correction amplifier (hybrid circuit)

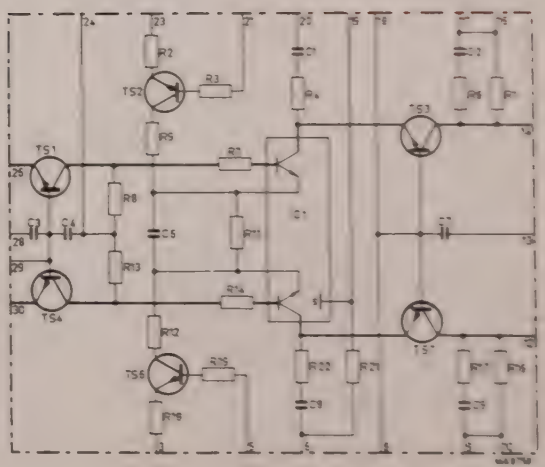


Fig. 3.45. Circuit diagram final amplifier (hybrid circuit)

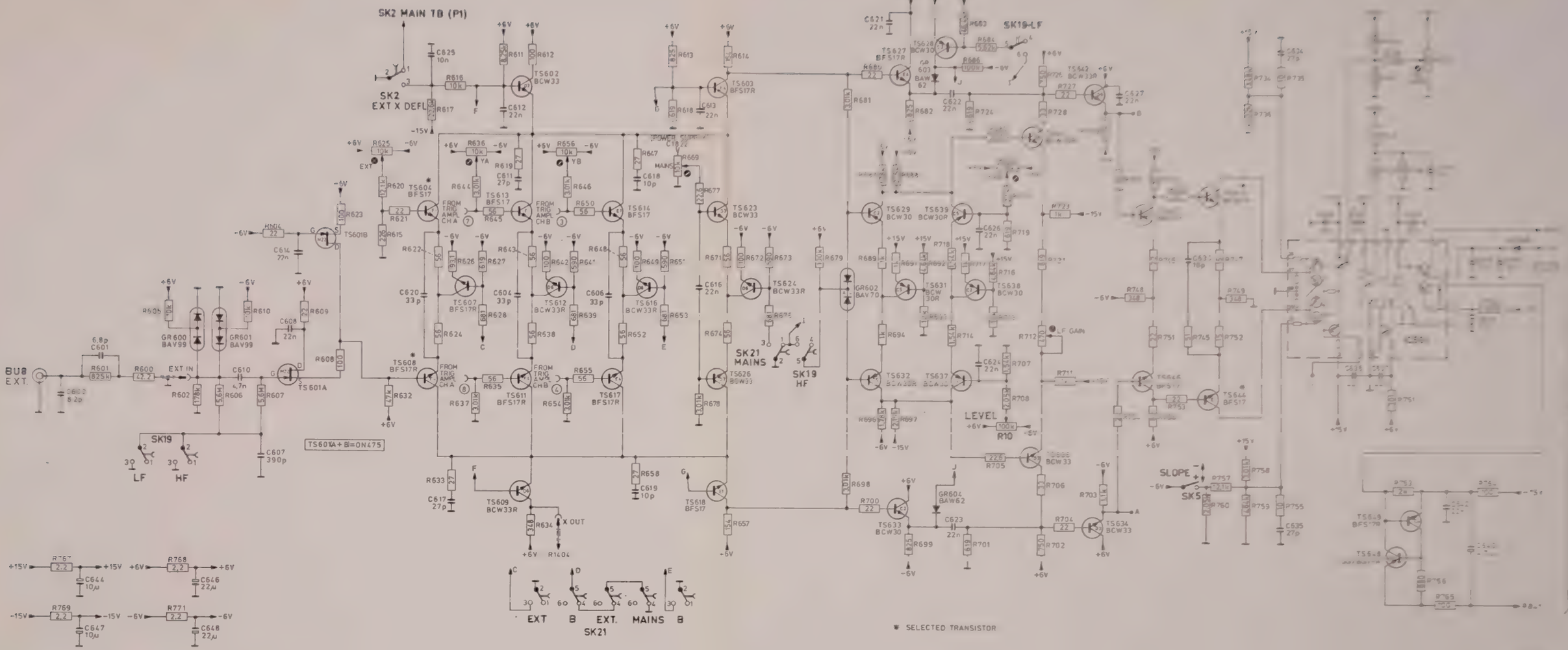


Fig. 3.46. M.T.B. trigger circuit diagram

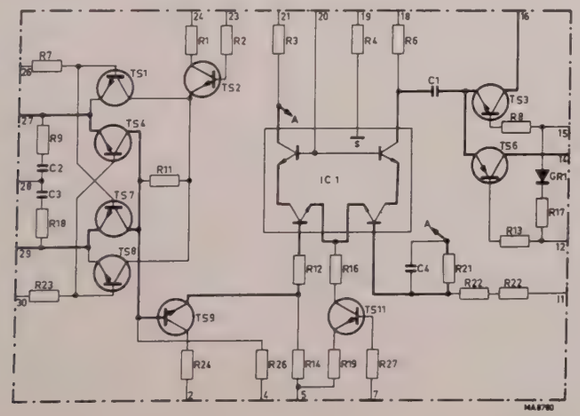


Fig. 3.47. Circuit diagram trigger-pulse shaper (hybrid circuit)

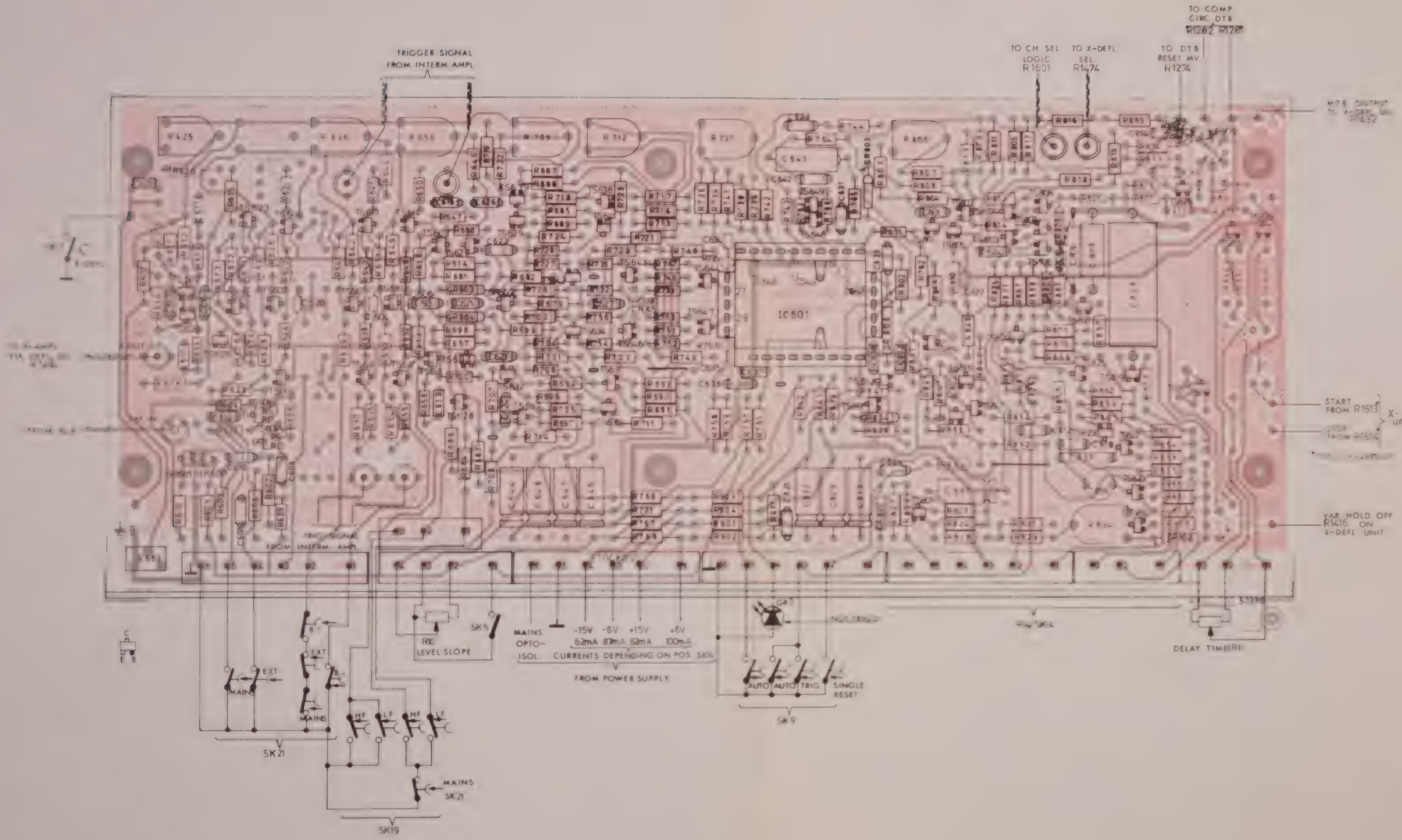


Fig. 3.48. M.T.B. circuit board

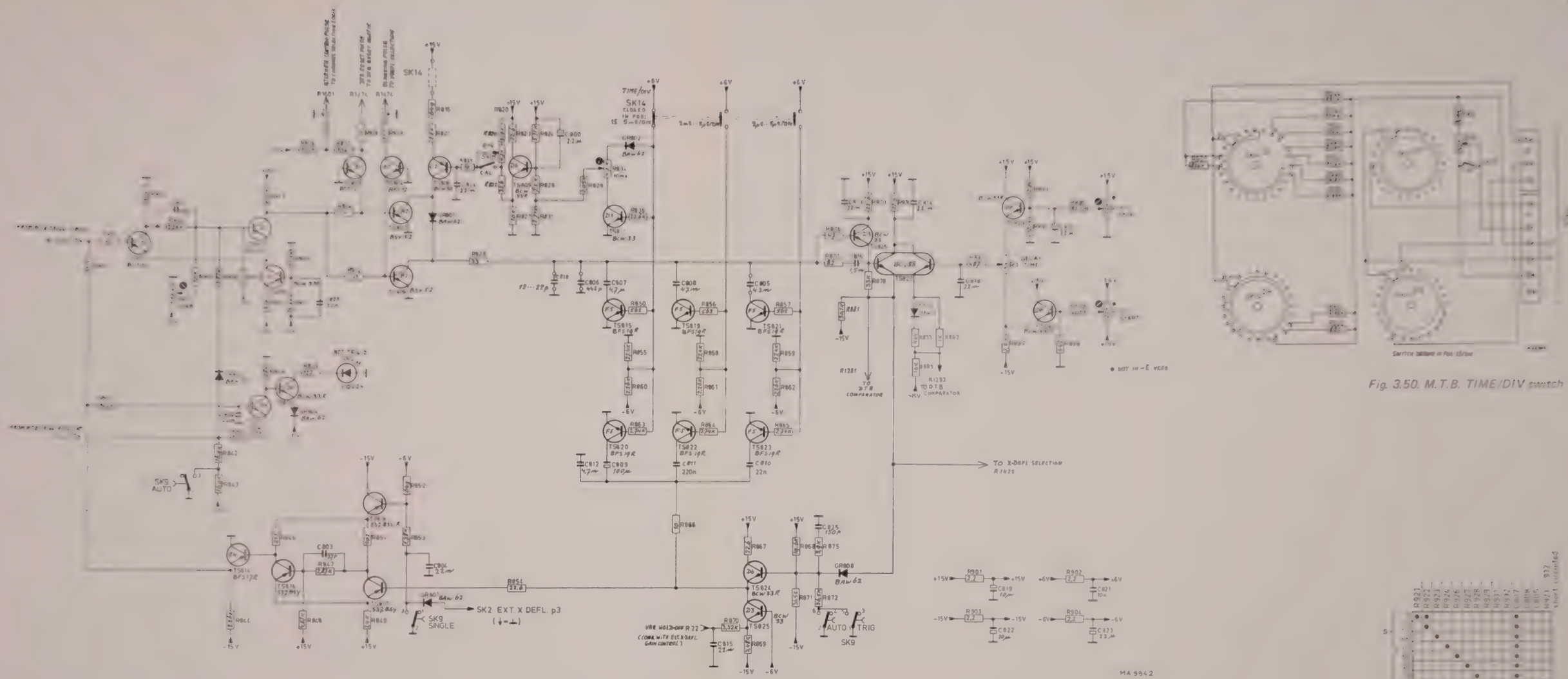


Fig. 3.50. M.T.B. TIME/DIV switch

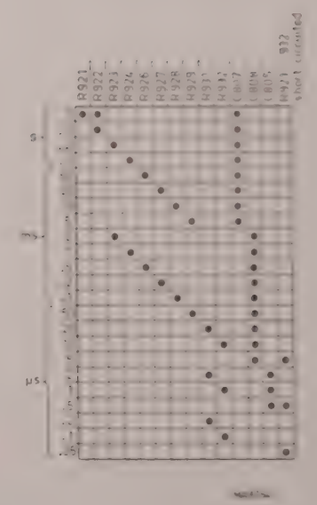


Fig. 3.51. Table of TIME/DIV switch positions

Fig. 3.49. M.T.B. sweep circuit diagram

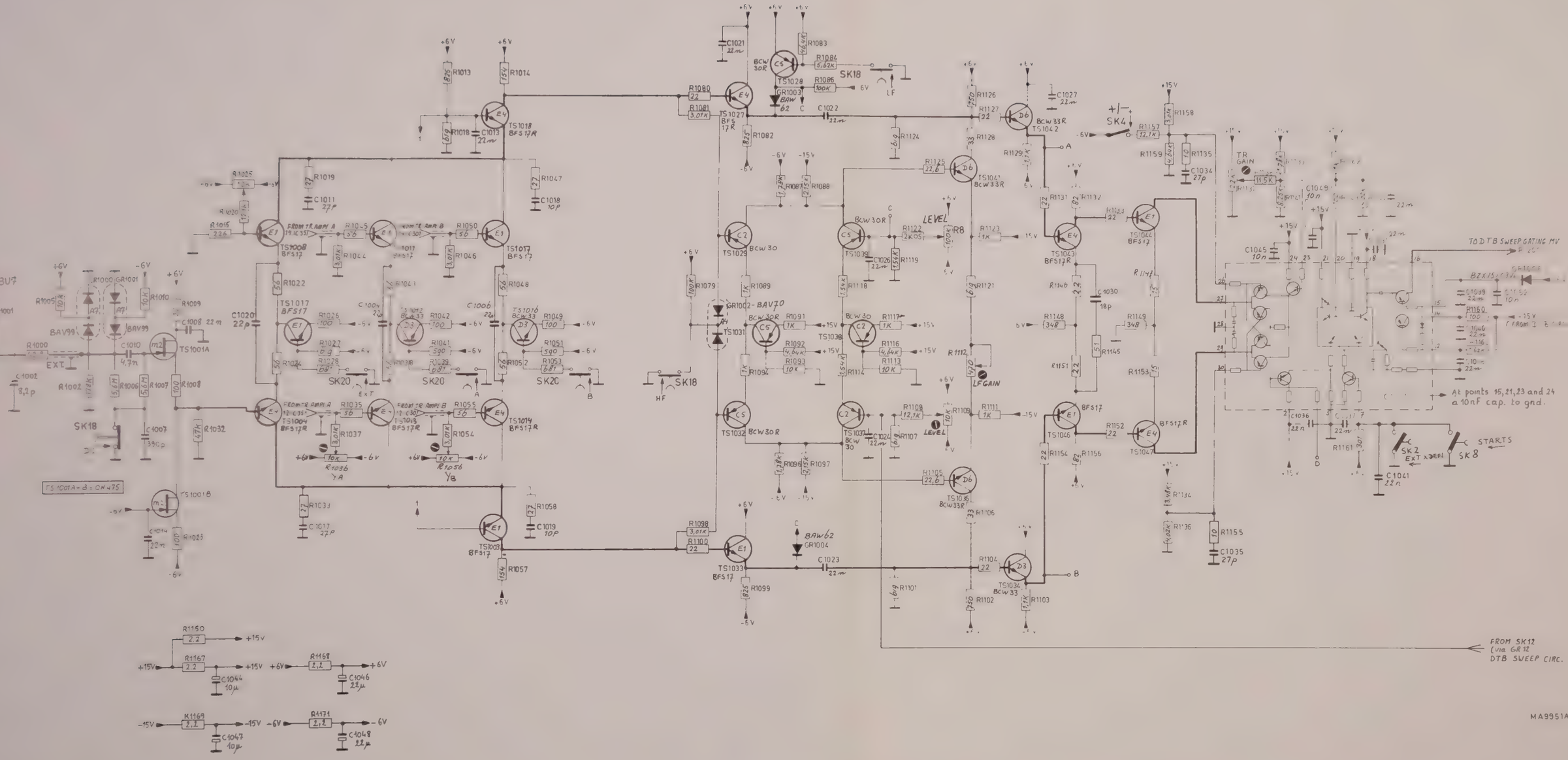


Fig. 3.52. D.T.B. trigger circuit diagram

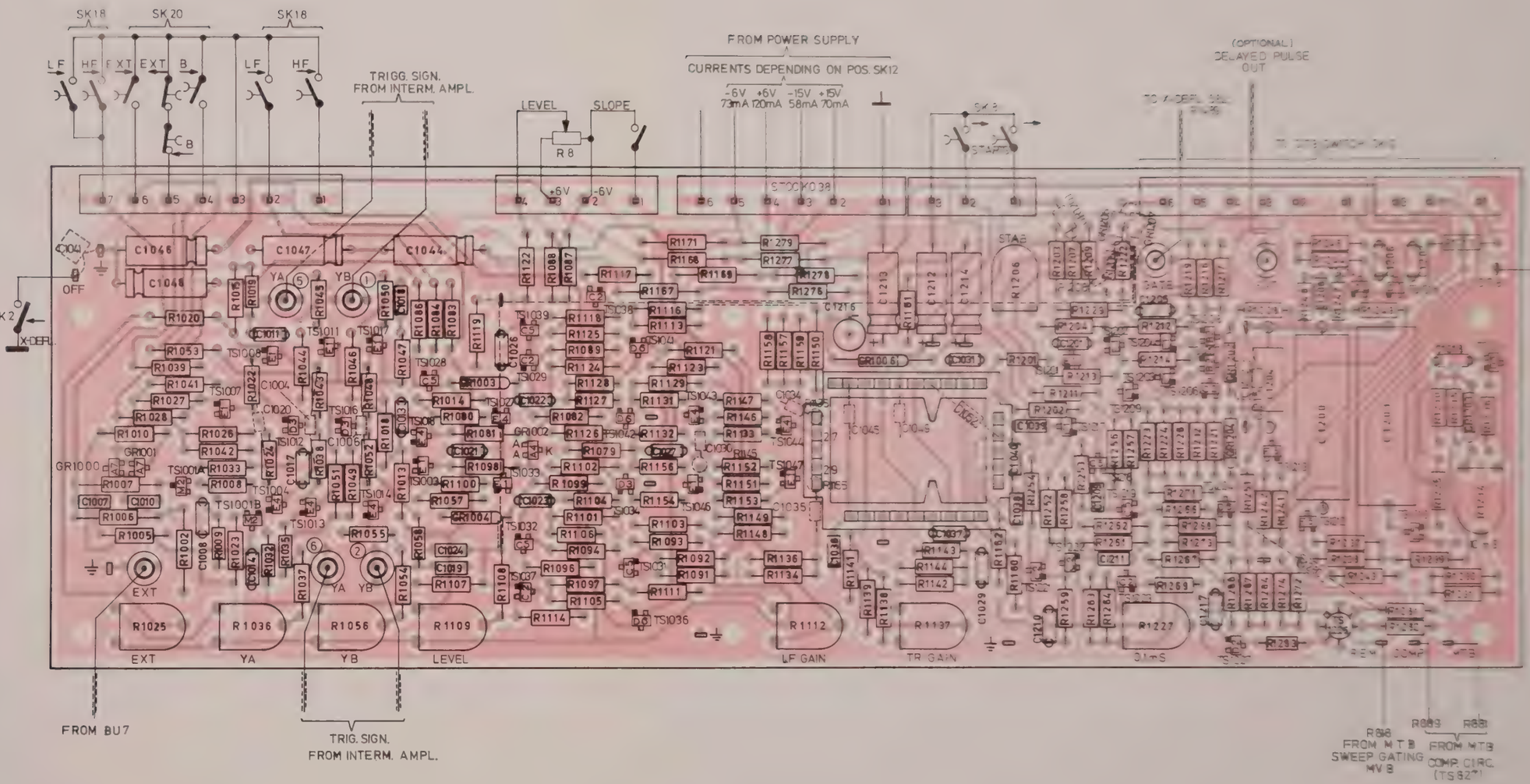


Fig. 3.53. D.T.B. circuit board

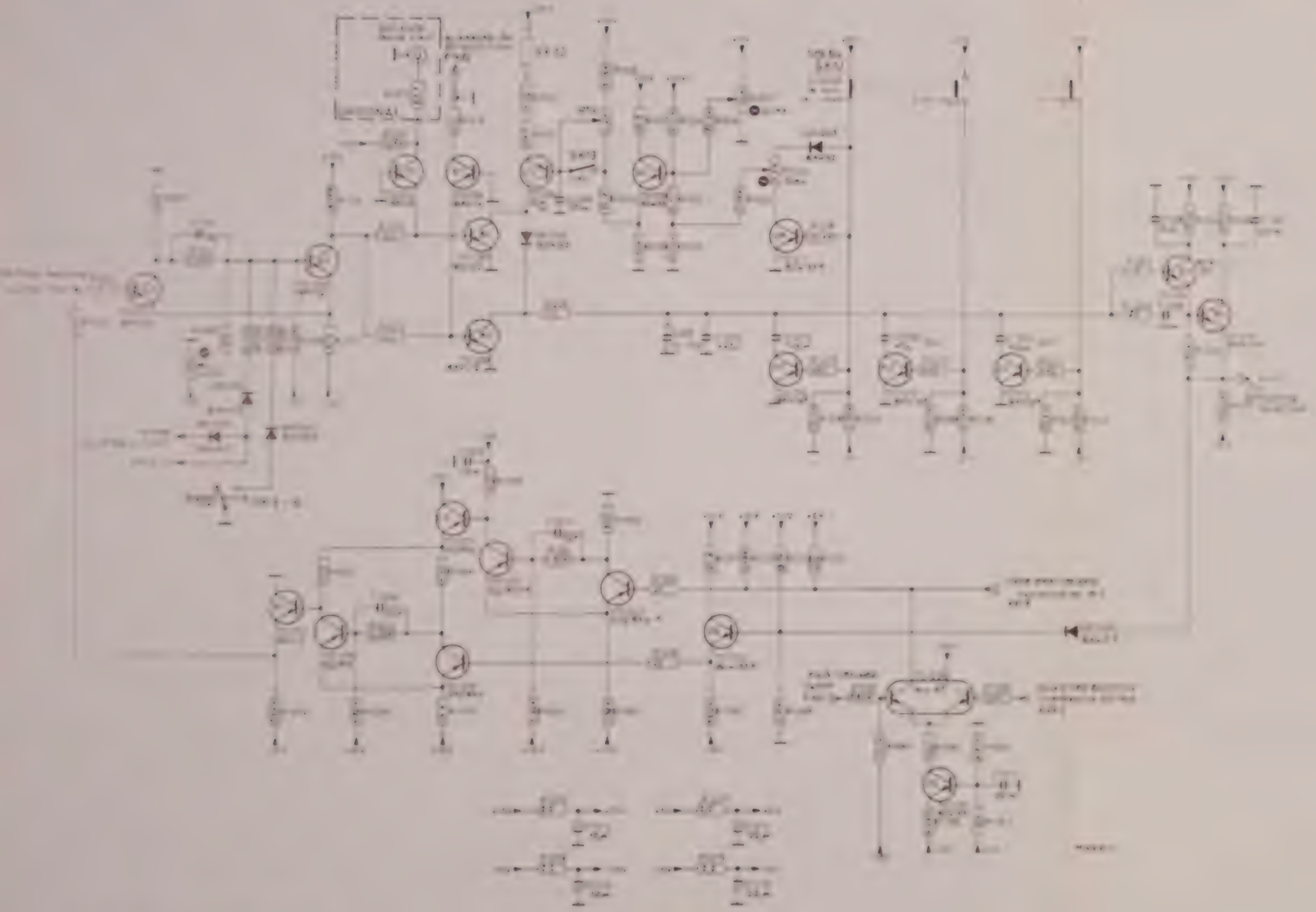


Fig. 3.54 D.T.B. sweep circuit diagram

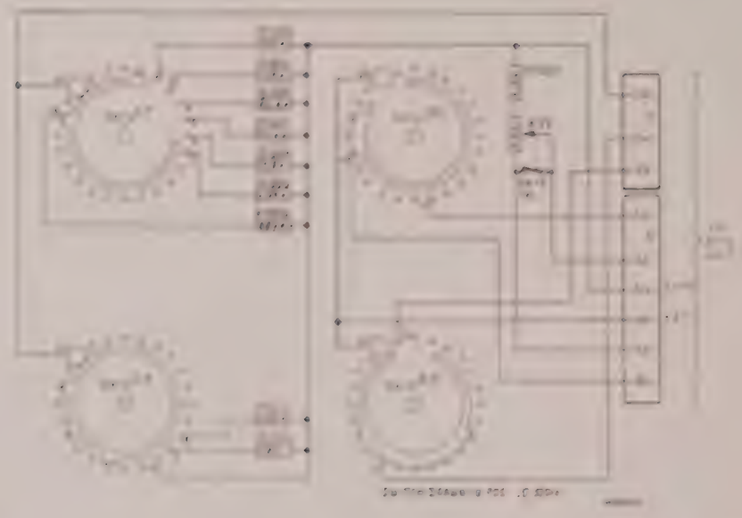


Fig. 3.55 D.T.B. TIME/DIV switch

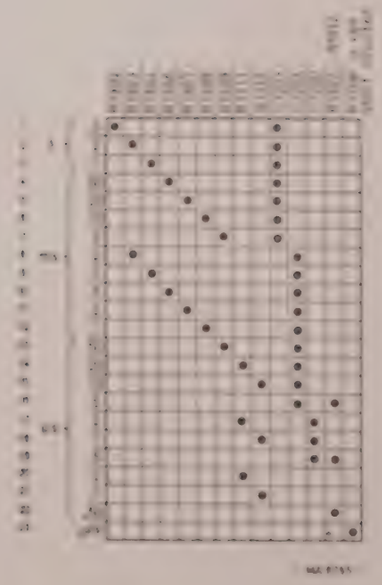


Fig. 3.56 Table of TIME/DIV switch positions

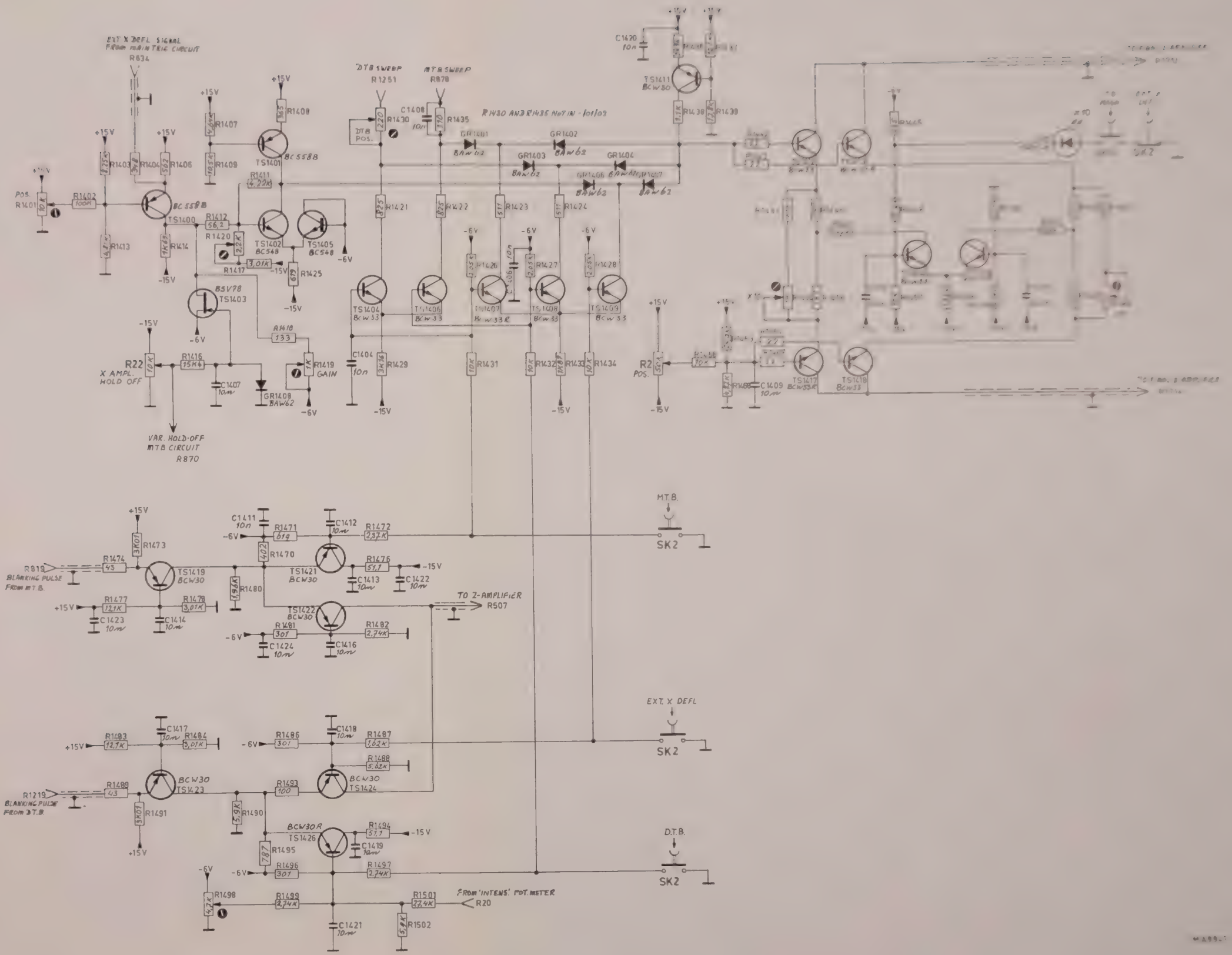


Fig. 3.57. X Deflection selector circuit diagram

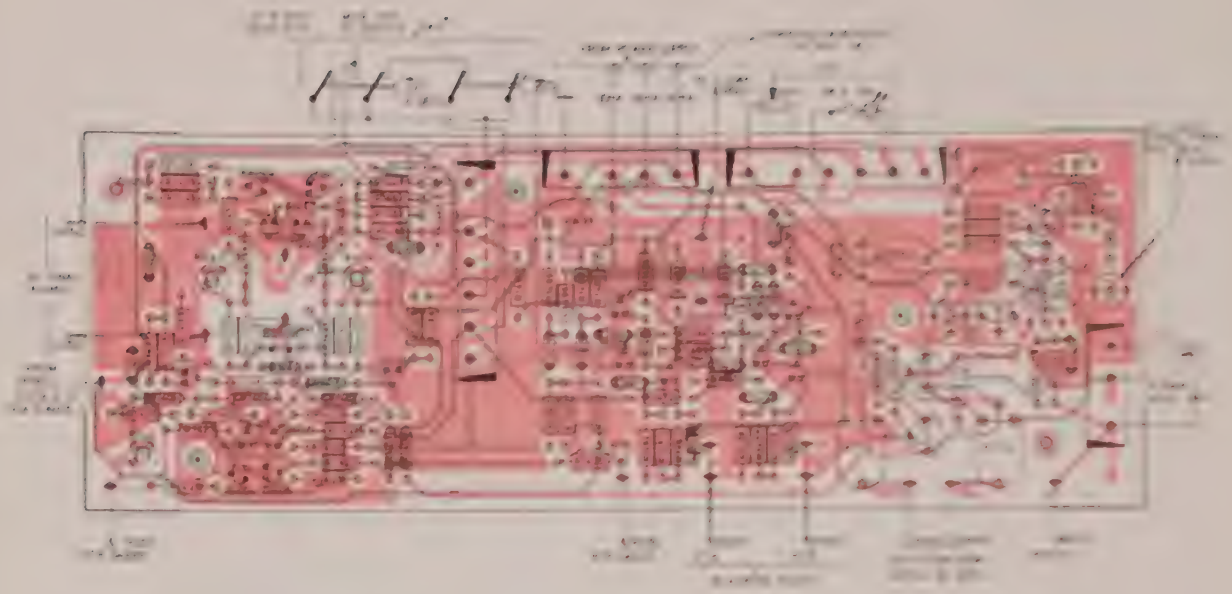


Fig. 3.58. X Deflection selector board PM 3260/03

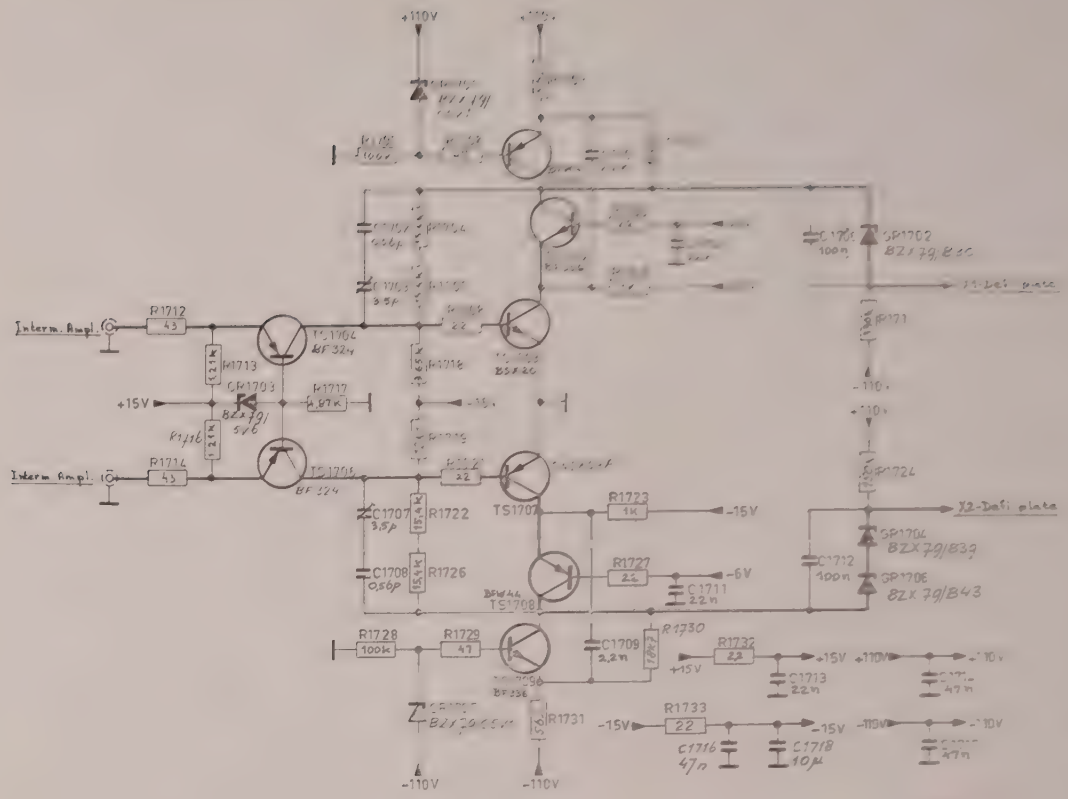


Fig. 3.59. Final X amplifier circuit diagram

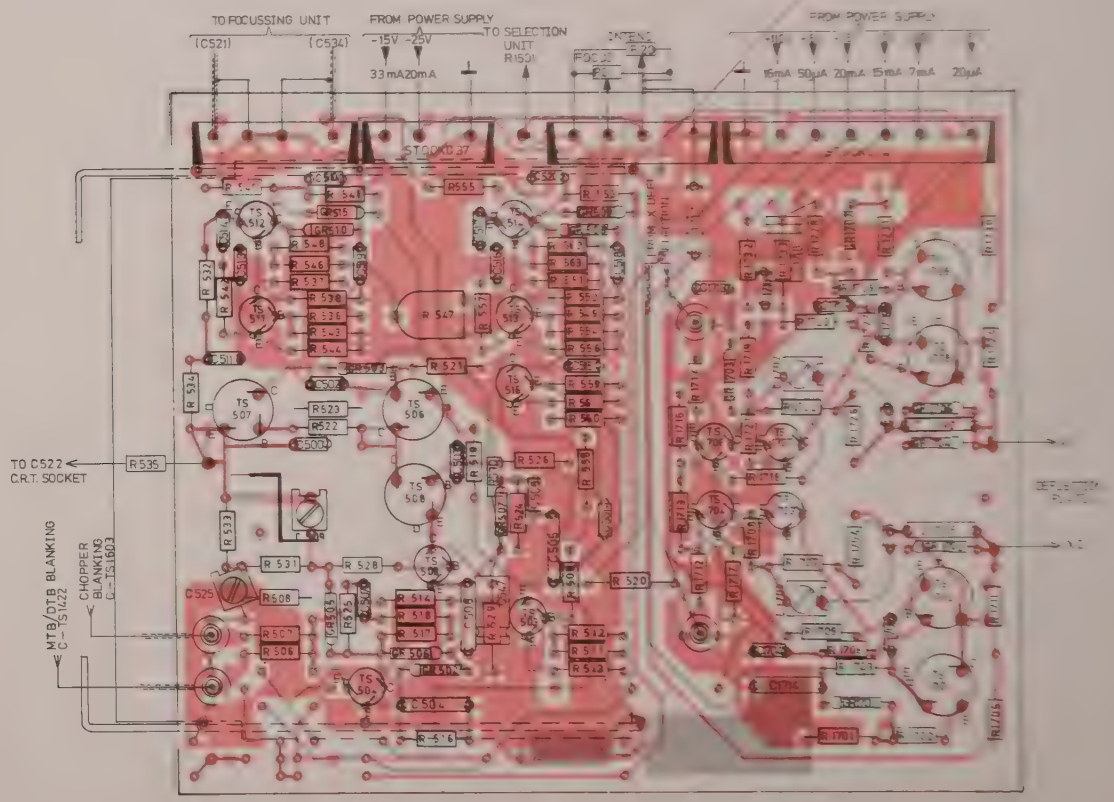


Fig. 3.60. Final X and Z amplifier board

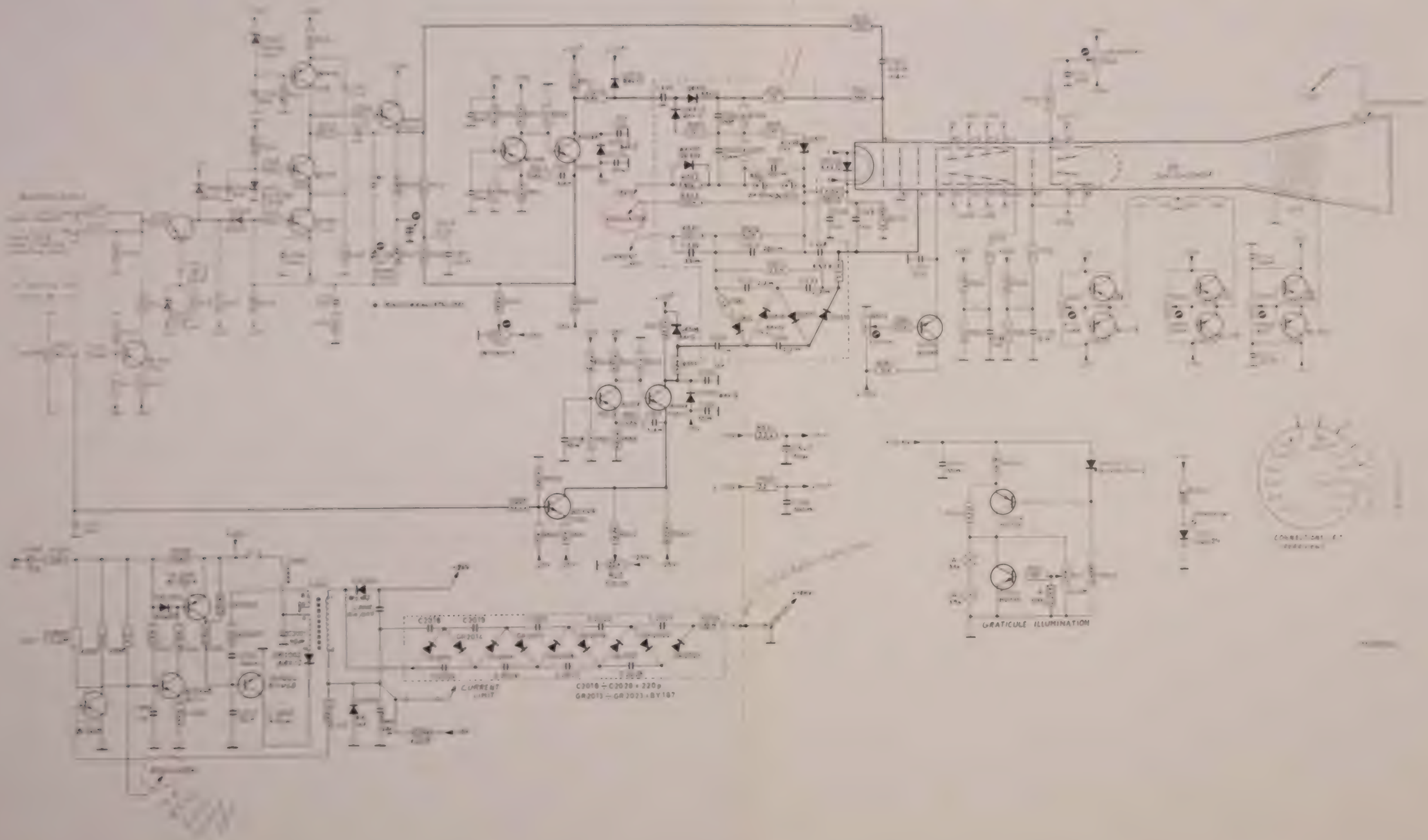


Fig.3.61. Z Amplifier, 2 kV and c.r.t. circuit diagram

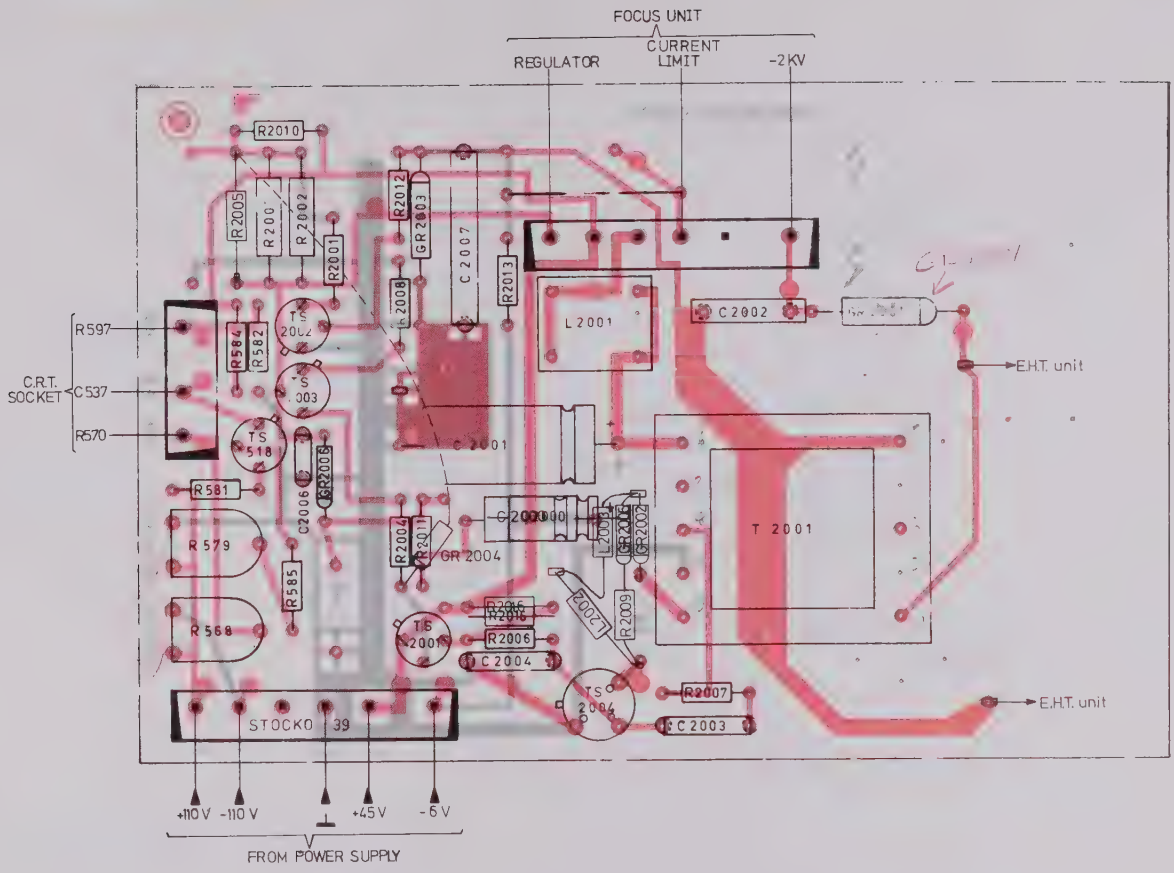


Fig. 3.62. 2 kV Unit

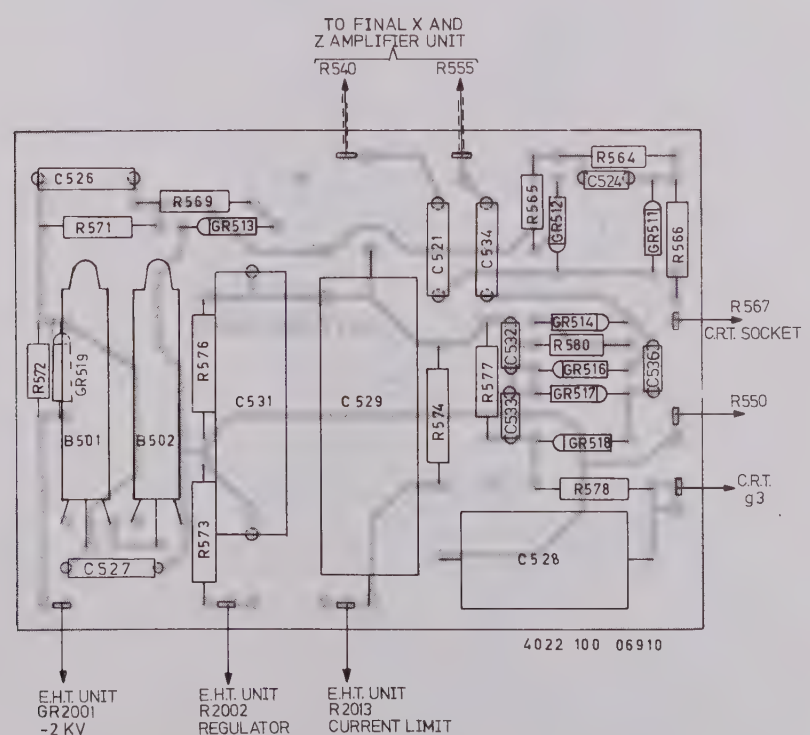


Fig. 3.63. Focus unit

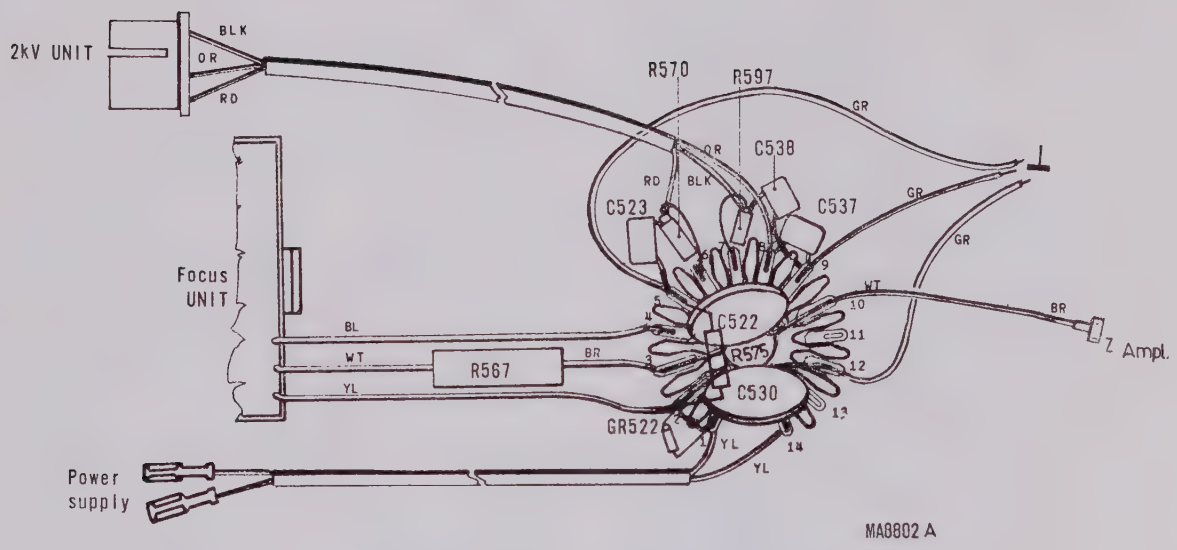


Fig. 3.64. C.r.t. socket assembly

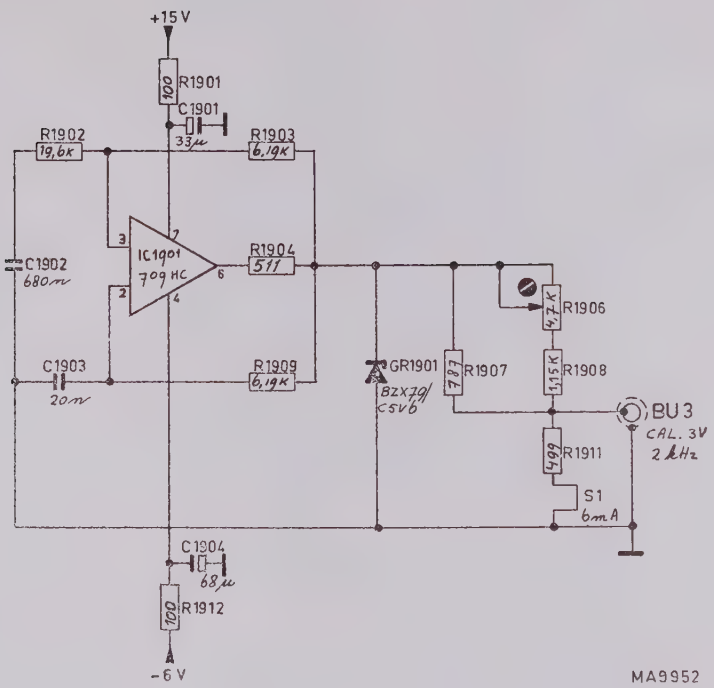


Fig. 3.65. Calibration circuit diagram

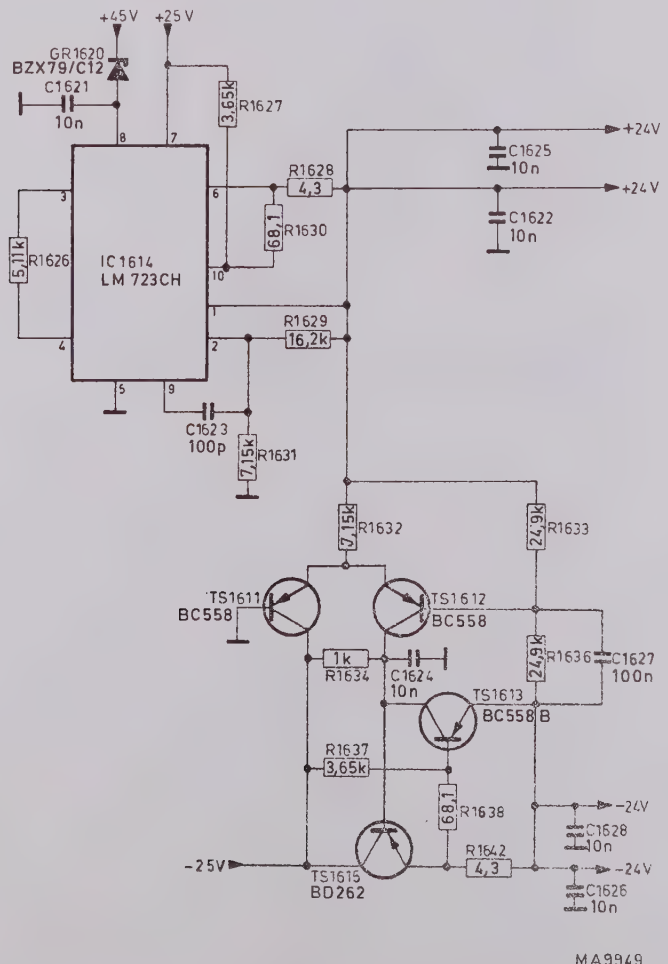


Fig. 3.66. Probe power circuit diagram

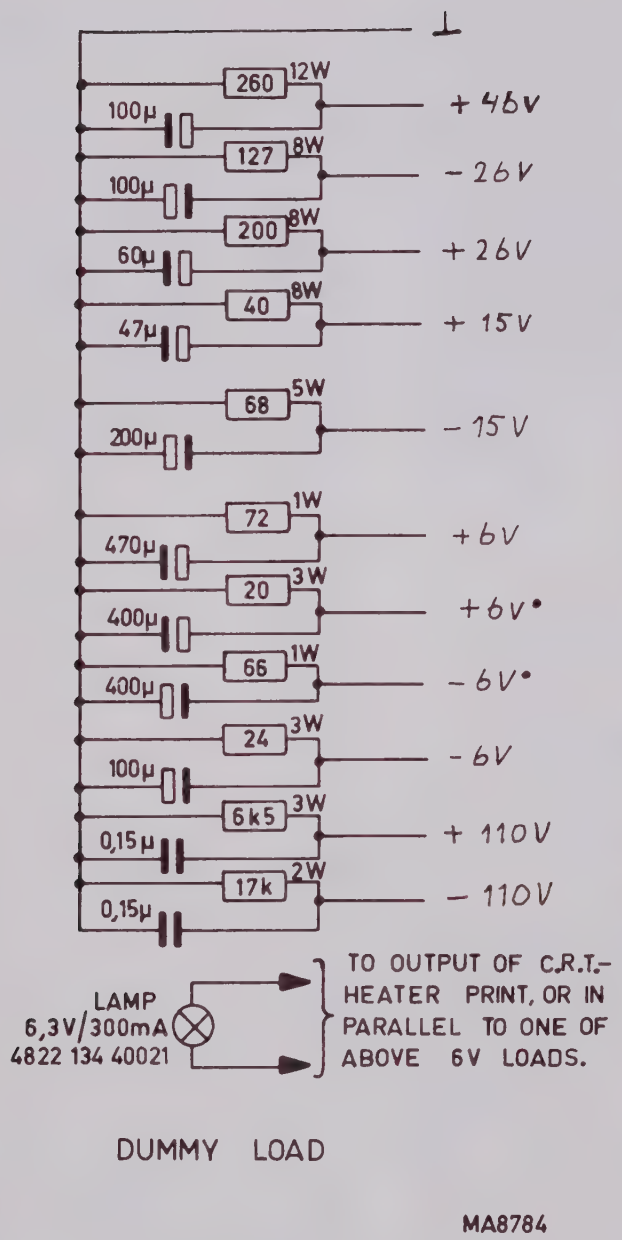
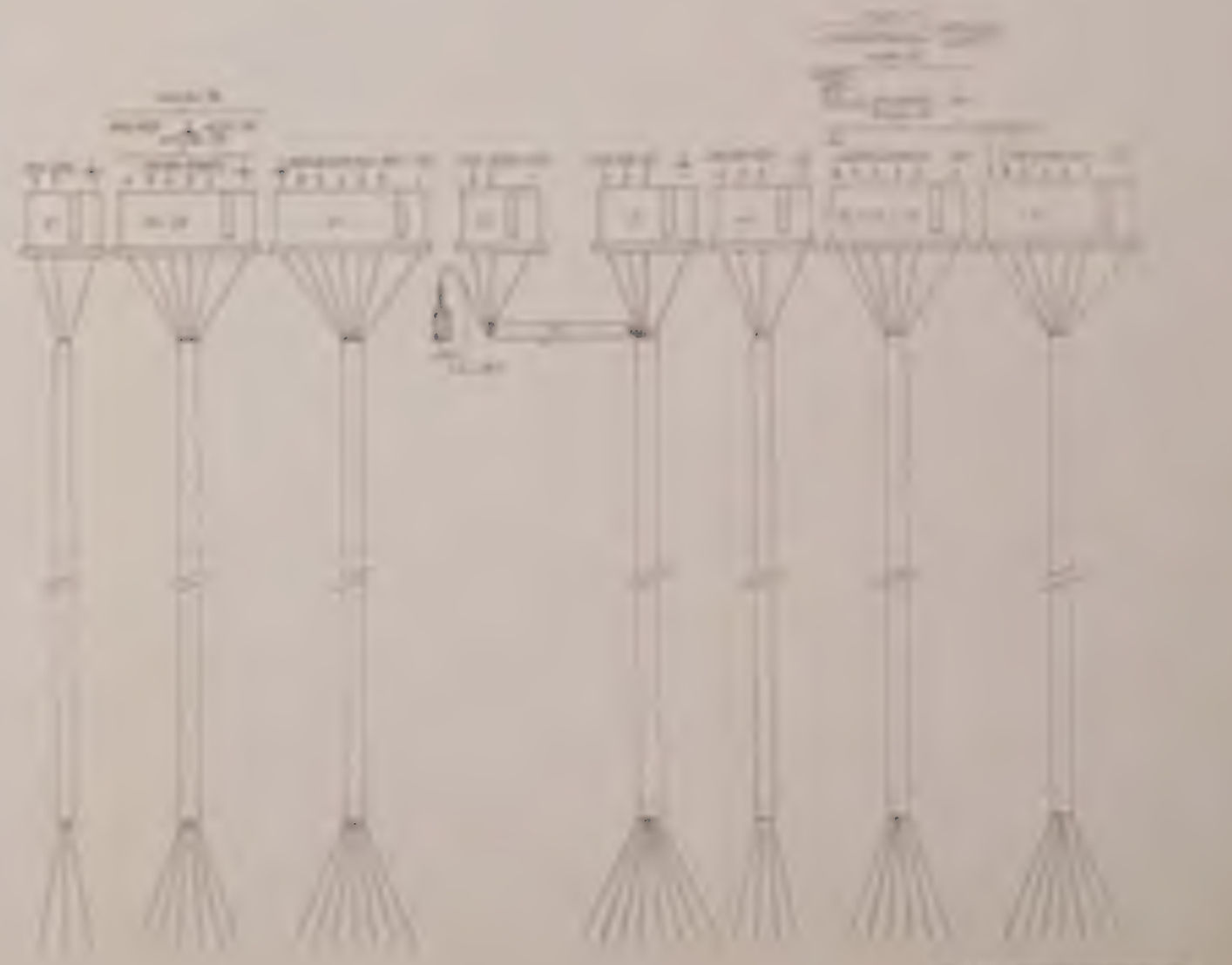


Fig. 3.67. Dummy load for power supply



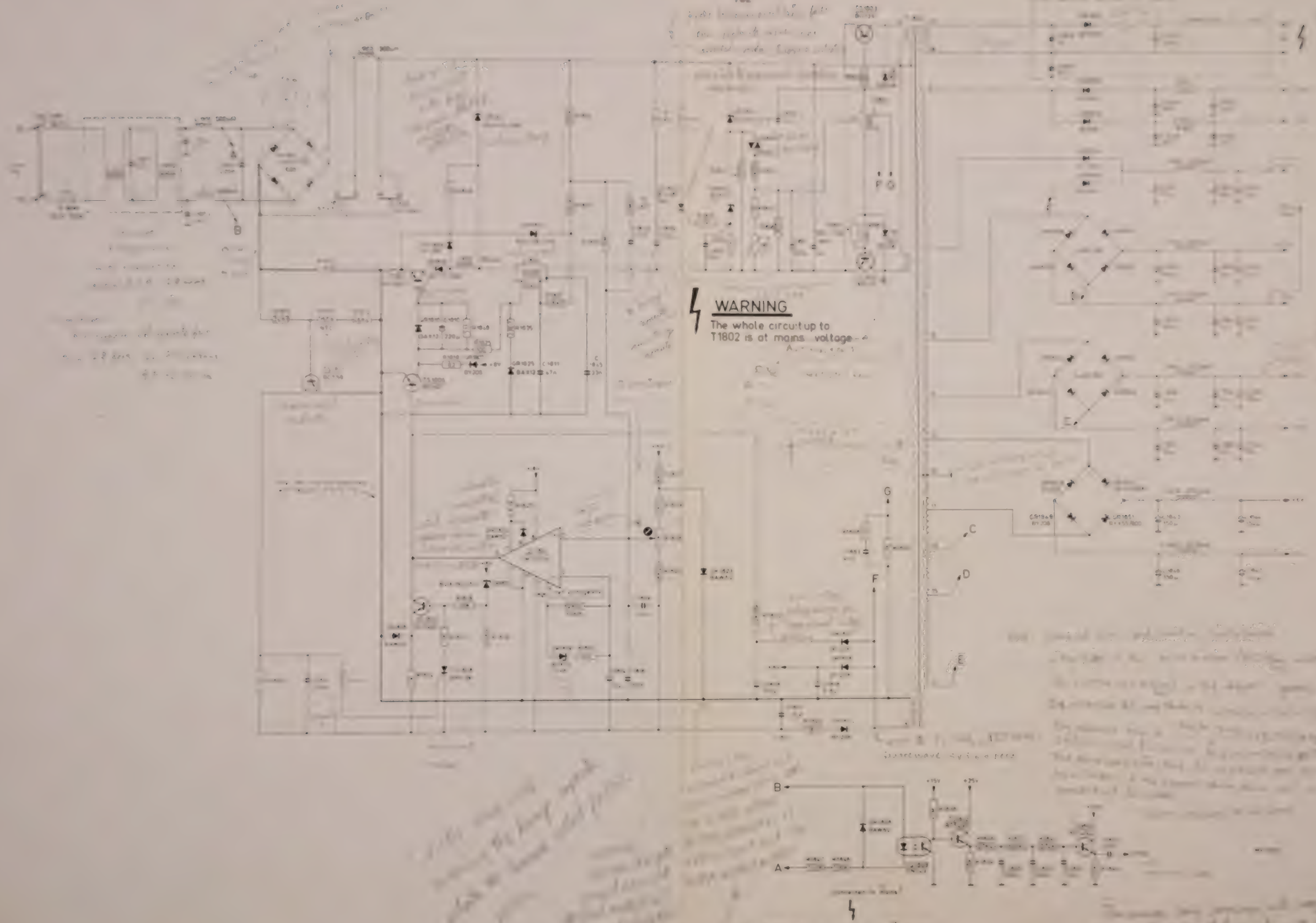
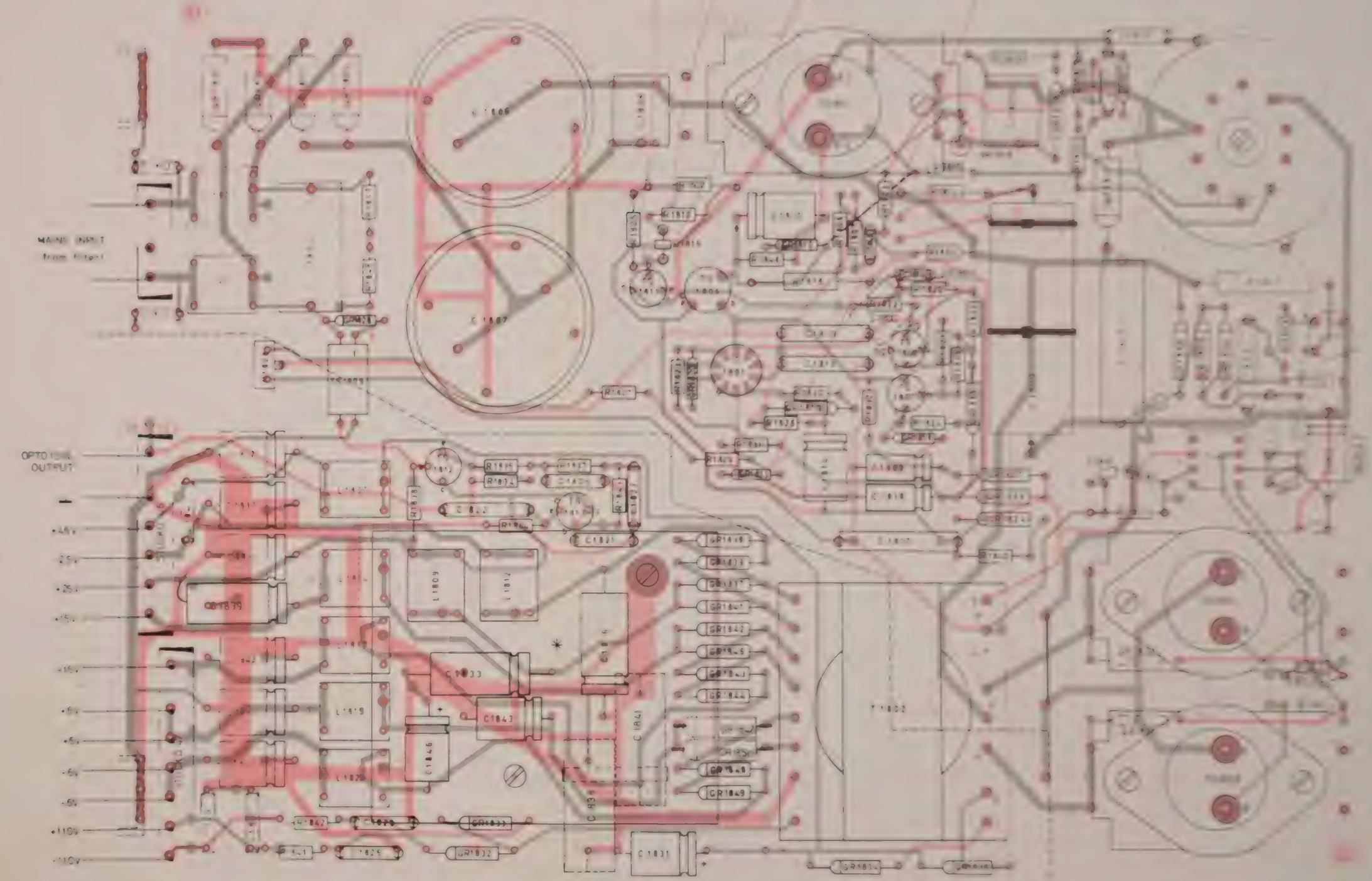


Fig. 3.69. Power supply circuit diagram


MAINS INPUT
from filter
OPTO ISOL
OUTPUT
+48v
+25v
+15v
+6v
-6v
+110v
-110v
C1833
C1843
C1845
C1841
C1831
L1809
L1812
L1819
L1820
GR1839
GR1842
GR1843
GR1844
GR1845
GR1846
GR1847
GR1848
GR1849
T1802
* CRT HEATER SUPPLY

Instruction manual

PM3261

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1. General information

1.1. INTRODUCTION

The PM 3261 is a standard PM 3260 oscilloscope, but provided with:

– delayed time-base with pulse counting (digital) delay

– TTL triggering for the main time base.

The pulse counting delay can be selected to any value (1 to 9999). The delayed time-base is triggered by the pulse which is shown in the display.
The number of pulses to be counted is selected by a up/down count control knob, and is shown on a four-digit seven-segment led display.

For the rest the PM 3261 is equal to the PM 3260 featuring the measurement of signals at a high sensitivity (5 mV/DIV) over a large bandwith (120 MHz).
Except the digital delayed time-base also the normal delayed time-base modes can be used.
The oscilloscope is provided with many thin-film integrated circuits, which guarantee a very stable operation and reduce the number of adjusting points.

There is a wide choice of display modes, such as one channel, two channels (alternately or chopped), two channels added with normal and inverted positions for both input signals.

The low-dissipation power supply works on any a.c. or d.c. voltage between 100 V and 240 V, thus obviating the need of adjusting the instrument to the local mains voltage.

All these features make the oscilloscope suitable for a wide variety of applications for the analog - as well as for the digital field of use.

If desired, the pulse counting delay circuit of the delayed time-base can be changed, to obtain a maximum of 99999 pulses to be counted. For further information on this modification refer to page 27.

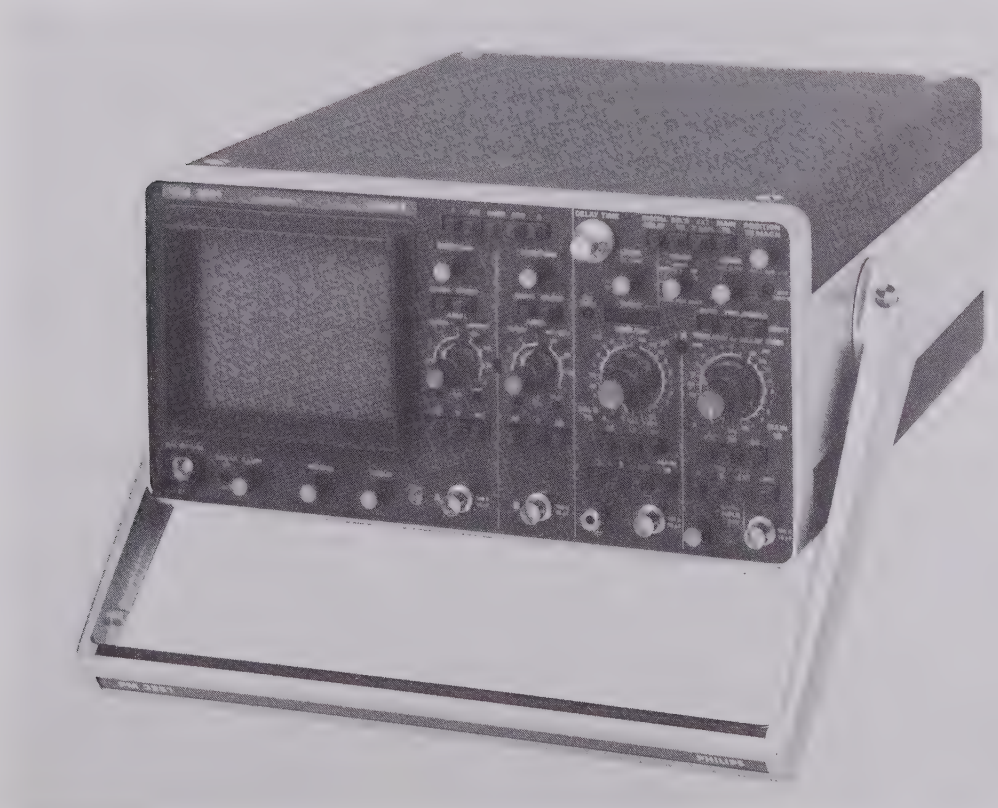


Fig. 1.1. Portable two channel 120 MHz Oscilloscope with digital delay PM 3261

1.2. CHARACTERISTICS

This specification is a valid after the instrument has warmed up for 30 minutes.
Properties expressed in numerical values with tolerances stated, are guaranteed by the manufacturer.
Numerical values without tolerances are typical and represent the characteristics of an average instrument.

This instrument has been designed and tested in accordance with IEC Publication 348 for Class I instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings which shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition.

Designation	Specification	Additional information
C.R.T.		
Type	PHILIPS D14-240	Rectangular tube face, domed mesh type, post-accelerator, metalbacked phosphor.
Measuring area	80 mm x 100 mm	Divided in 8x10 divisions
Screen type	P31 (GH) phosphor	P7 (GM) phosphor optional
Photographic writing speed	> 1500 cm/μs	Measured with Steinheil Oscillophot M5 camera Aperture: 1:1,2 Object to image ration 1:0,5 Film: Polaroid 410 (10000 ASA) No pre-fogging Phosphor type P31 (GH)
Total acceleration voltage	19 kV	
Graticule	Internal	Continuously variable illumination
Engravings	Centimetre divisions with subdivisions of 2 mm along the central axes. Dotted lines indicate 10 % and 90 % of measuring lattice for measurement of rise time.	
VERTICAL OR Y AXIS		
Number of channels	2	A and B
Response		
Frequency range	d.c. ... 120 MHz	– 3 dB upper bandwidth limit, d.c. coupled
	10 Hz ... 120 MHz	– 3 dB bandwidth, a.c. coupled
Rise time	≈ 3 ns	
Pulse aberrations	± 3 % (4 % peak-to-peak)	
Deflection coefficients	5 mV/DIV ... 2 V/DIV	Nine calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1: ⩾ 2,5
Error limit	± 3 %	
Max. permissible input voltage	± 400 V	d.c. + a.c. peak. Up to 20 mV position of input attenuator derating at frequencies over 500 kHz. See Fig. 1.2.
Instability of the spot position		
Trace jump	< 0,3 Div.	When switching between any of the attenuator positions
Trace jump	< 0,3 Div.	When switching the NORM/INVERT switch.

Designation	Specification	Additional information
Trace shift	< 0,3 Div.	When rotating the continuous attenuator.
Trace shift	< 1 Div.	When switching to the ADDED position.
Temperature drift	< 60 μV/^{o}C	Typical value.
Maximum deflection		
Undistorted	24 divisions	
Shift range	16 divisions	8 divisions each in topward and downward direction reckoned from the central horizontal graticule line.
Input impedance	1 MOhm//15 pf	
Input RC time	⩾ 17 ms	Coupling switch to AC
Visible signal delay	Approximately 30 ns	
Display modes	Channel + or – A only Channel + or – B only Channels ± A and ±B chopped Channels ± A and ±B alternate Channels ± A and ±B added	
Chopper frequency	1 MHz	
Cross-talk between channels	1:500	2 divisions of signal amplitude at 50 MHz on one channel set to .2 V/DIV Cross-talk is measured on other channel set to 20 mV/DIV
Common-mode rejection factor	100 at 100 kHz 100 at 2 MHz 20 at 50 MHz	Measured with + A and – B added; max. common mode signal 8 divisions

HORIZONTAL OR X AXIS

Display modes	Main time base Main time base with intensified delayed time base after normal delay time, or digital delay.	
	Delayed time base X-Y	After normal delay time, or digital delay. X deflection by: – Channel A signal – Channel B signal – Signal applied to EXT connector of main time base – Line voltage

X DEFLECTION VIA CHANNEL Y_A OR Y_B

Deflection coefficient	5 mV/DIV ... 2 V/DIV	Uncalibrated continuous control ⩾ 3:1 via X AMPL potentiometer
Coefficient error	± 5 %	
Bandwidth	0 ... 2 MHz	– 3 dB bandwidth over 8 DIV
Input impedance	1 MOhm//15 pF	
Phase difference	3^{o} at 100 kHz	

Designation	Specification	Additional information
External X deflection via EXT socket		
Deflection coefficient	200 mV/DIV	One calibrated position Uncalibrated continuous control ⩾ 3:1
Bandwidth	0 ... 2 MHz	– 3 dB bandwidth over 8 DIV
Input characteristics	Identical to Y channels	
Phase difference	3° at 100 kHz	
Max. permissible input voltage	± 400 V	d.c. + a.c. peak. Derating at high frequencies; see Fig. 1.2.
X deflection with internal voltage at line frequency		
The deflection depends on the line voltage and has been factory-adjusted to 8 DIV at a line voltage of 220 V.		
MAIN TIME BASE		
Time coefficients	1 s/Div ... 50 ns/Div	Twenty-three calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1: ⩾ 2,5 between the steps
Coefficient error	± 2 % ± 3 %	+ 20 °C ... + 30°C + 5 °C ... + 40 °C Sweep accuracy over any two divisions of 10 DIV sweep is ± 5 %. Exclude the first and last DIV at the 5 ns and 10 ns magnified sweep rates.
Magnifier		
Magnification	10x	Switched, calibrated
Additional error	± 1 %	First and last Div. of 5 ns, 10 ns and 20 ns magnified sweep rates excluded.
Max. effective time coefficient	5 ns/Div.	
Variable hold-off time	The sweep hold-off time is continuously adjustable to at least a factor of 10	
MAIN TIME BASE TRIGGERING		
Modes	Auto	Automatic free-run of the time-base generator approx. 100 ms after disappearance of the trigger signal.
	Trig Single sweep	
Sources	Internal from ch. A Internal from ch. B External Internal from line	 Via EXT input Via build-in opto-isolator
Signal selection	TTL DC AC	Automatic TTL triggering 0-120 MHz 20 kHz (–3 dB) - 120 MHz
	Above stated bandwidth applies to both internal and external signals	
TTL logic levels	Low High Trigger gap Temp. range	+ 0,8 V (± 0,4 V) + 2 V (± 0,4 V) 1,2 V 15° ... 30°C
	These data apply to voltages on the tip of a 1:10 attenuator probe connected to the EXT input socket.	
	When the trigger signal is taken internally from ch. A or ch. B the corresponding input-attenuator must be set in such a way that the TTL-signal display height is 2 divisions.	
	TTL triggering cannot be used with LINE as trigger source.	

Designation	Specification	Additional information
Slope	+ or –	
Sensitivity	Internal ⩽ 0,5 DIV External ⩽200 mV	Typical sensitivity as a function of the frequency, refer to Fig. 1.3.
Level range	24 DIV – 3,6 V to + 3,6 V	Internal External
	Above Sensitivity and Level range data apply to AC or DC triggering	
Ext. Input	1 MOhm//15 pF	Identical to Y input
Max. permissible input voltage	± 400 V	d.c. + a.c. peak.
DELAYED TIME BASE		
Operation		
Normal delay operation	Direct after delay-time Triggerable after delay time	Started by main time-base Triggerable by the signal from ch. A, ch. B, or external
Digital delay	By pulse counting	Pulses from ch. A, or ch. B, or external
Time coefficients	0,5 s/DIV ... 50 ns/DIV	Twenty-two calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1: ⩾ 2,5 between the steps.
Coefficient error	± 2 % ± 3 %	+ 20 °C ... + 30 °C + 5 °C ... + 40 °C Sweep accuracy over any two divisions of 10 DIV sweep is ± 5 %. Exclude the first and last DIV at the 5 ns and 10 ns magnified sweep rates.
Delay time	Continuously variable between 0x and 10x the time coefficient of the main time base	Range delay-time multiplier 0,00 - 9,99. Incremental accuracy 0,5 %; typical 0,2 %.
Delay-time jitter	1:20 000	Typical value 1:30 000
Delayed gate output	Rear panel BNC connector providing logic "1" TTL output pulse during main time base intensified and delayed time base running times.	
	Output impedance 3 kOhm	Short-circuit proof.
DELAYED TIME BASE TRIGGERING		
Sources	Internal from ch. A Internal from ch. B External	Triggerable after delay interval.
	MTB	Triggered by main sweep immediately after delay
Signal selection	DC LF-internal LF-external HF	0-120 MHz 0-20 kHz (–3 dB) 10 Hz-20 kHz; –3 dB 20 kHz-120 MHz; –3 dB
Slope	+ or –	
Sensitivity	Internal ⩽ 0,5 DIV External ⩽200 mV	Typical sensitivity as a function of the frequency, see Fig. 1.3
Level range	24 DIV – 3,6 V to + 3,6 V	Internal External
Ext. Input impedance	1 MOhm//15 pF	Identical to Y input
Max. permissible input voltage	± 400 V	d.c. + a.c. peak.

Designation	Specification	Additional information
Digital delay operation	The digital delay is operative if the DIG DELAY pushbutton is depressed	The position MAIN TB of the DELAYED TB TRIG source overrules the DIG DELAY function. So the trigger source A, B or EXT should be selected.
Event number setting	The event number can be set to any value between 0000 and 9999.	The circuit is layed out to accomodate for event numbers between 00000 and 99999.
	This number is preset to 0001 when dig delay is selected and when the instrument is switched on.	The presetting to 0001 applies only when the count potmeter is in the stop position.
Event number control	The event number can be increased by setting the count potmeter in the up position	There is a mechanical lock for the stop position. From 9999 the event will go to 0000.
	In the down position the event number will decrease	From 0000 the event number will go to 9999.
Up/down count potmeter	The event number will be changed with a count rate proportional to the rotation of count potmeter out of the stop position.	
Up/down count rate	Slow: $\leqslant$ 1 Hz to $\geqslant$ 60 Hz	Typ 0,7 Hz to 100 Hz Count potmeter control depressed. When the potmeter is set out of the stop position the event number will increase or decrease by 1 immediately.
	Fast: $\leqslant$ 20 Hz to $\geqslant$ 1 kHz	Typ 10 Hz to 1,5 kHz Count potmeter control pulled.
Events	Events are trigger points selected by the delayed time base trigger control	
Event counter	The event counter counts events starting with the first event after the set up time T_s. When the event counter has counted the selected number of "Event −1" the counter delivers a ready pulse to the delayed time base which will start on the first trigger pulse after T_{dr} Refer to Fig. 1.4	T_s is the time by which the trigger point of the delayed time base must be delayed in respect to the trigger point starting the main time base in order to be recognized by the event counter as event number 1. T_s is typ 15 ns. T_{dr} is the time between the trigger point which is the selected event number −1 and the time that the delayed time base is ready to start on the next trigger pulse. T_{dr} is typ 45 ns. When the event number is set to 0000 or 0001 the ready pulse is present already during the start of the Main time base. The Delayed time base requires then a typ 25 ns to be enable by the start of the main time base.

Designation	Specification	Additional information
Max Event rate	Max event rate ⩾ 50 MHz	This is the rate of events which can be recognized by the event counter
Event pulse width	⩾ 10 ns	This is the minimum pulse width of the trigger signal of the delayed time base following the selected trigger slope in order to be recognized by the event counter.
Delayed time base NOT TRIG'D lamp	Warns for loss of trigger and or wrong setting of time base combination.	Can be used as selective logic probe under single shot conditions

CALIBRATOR

Voltage	3 V_{p-p}	Positive square wave, base-line zero volts
Current	6 mA	Through current loop
Accuracy	± 1 %	For both voltage and current
Frequency	2 kHz ± 2 %	
Protection	The output is short-circuit-proof	

POWER SUPPLY

Line voltages	AC: 100 ... 240 V, ± 10 % DC: 130 ... 350 V, ± 10 %	90 VAC at specified line voltage distortion of peak/rms ratio: $\sqrt{2}$ ± 2 % and B ⩽ 0,005 (IEC 359)
Line frequency	46 to 440 Hz	or DC
Build-in line fuse	2 amps, slow-blow	For all line voltages
Power consumption	45 W	

ENVIRONMENTAL CAPABILITIES

The environmental data are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, HOLLAND.

Ambient temperature	+ 5 °C ... + 40 °C	Rated range of use
	− 10 °C ... + 55 °C	Limit range of operation
	− 40 °C ... + 70 °C	Storage and transport conditions
Altitude	5 000 m	Operating
	15 000 m	Not operating
Humidity	The instrument meets the requirements of the IEC 68 dB recommendations.	
Bump	1000 bumps of 10 g, ½ sine, 6 ms duration, in each of 3 directions.	
Vibration	30 minutes in each of three directions, 10-150 Hz; 0,7 mm p-p and 5 g max. acceleration	

Designation	Specification	Additional information
Recovery time	15 minutes	Coming from — 10 °C and going to + 20 °C at 60 % relative humidity
	WARNING: When an instrument is brought from the cold into a warm environment, condensation may cause a hazardous condition. Therefore, make sure that the earthing requirements are strictly adhered to.	

MECHANICAL DATA

Dimensions	Length 410 mm (16 1/4") Width 316 mm (12 1/4") Height 154 mm (6 1/8")	Excl. controls, cover and feet
Weight	9,3 kf (20,5 lbs)	

ACCESSORIES

Accessories delivered with the instrument

One contrast filter
Front cover with storage space
Collapsible viewing hood PM 9366
Banana - BNC adapter PM 9051
CAL terminal - BNC adapter
Manual

Optional accessories

Probes

PM 9335	1:1 voltage probe, 1,5 m cable
PM 9335L	1:1 voltage probe, 2,5 m cable
PM 9347	Active T.V. probe
PM 9351	1:10 voltage probe, 1,5 m cable
PM 9351L	1:10 voltage probe, 2,5 m cable
PM 9352	Active 10:1 micro-miniature probe (100 kohm//6 pF)
PM 9353	Active FET probe
PM 9355	Current probe (50 MHz)
PM 9358	1:100 H.V. probe 5,6 kV max. (20 MOhm//2 pF)

Miscellaneous

PM 8901	Battery pack
PM 8910	Polaroid anti-glaze contrast filter
PM 8960	Rack-mounting adaptor
PM 8971	Camera adaptor for PM 9380
PM 8980	Long viewing head
PM 8991	Trolley
PM 8992	Accessory poush
PM 9346	Probe power supply (+ 24 V, — 24 V, 2x50 mA)
PM 9380	Oscilloscope camera
M3...M5	Oscilloscope camera Steinheil Oscillosphot

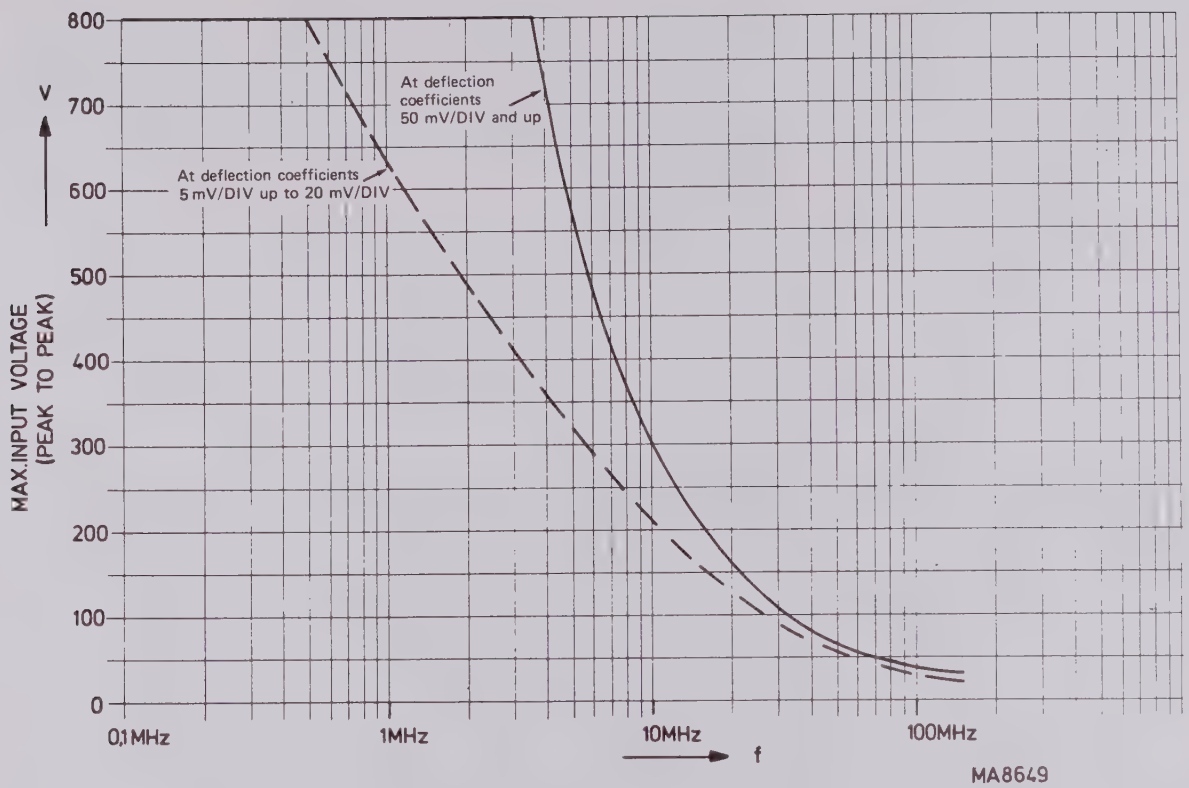


Fig. 1.2. Derating of the maximum permissible input voltage as a function of frequency

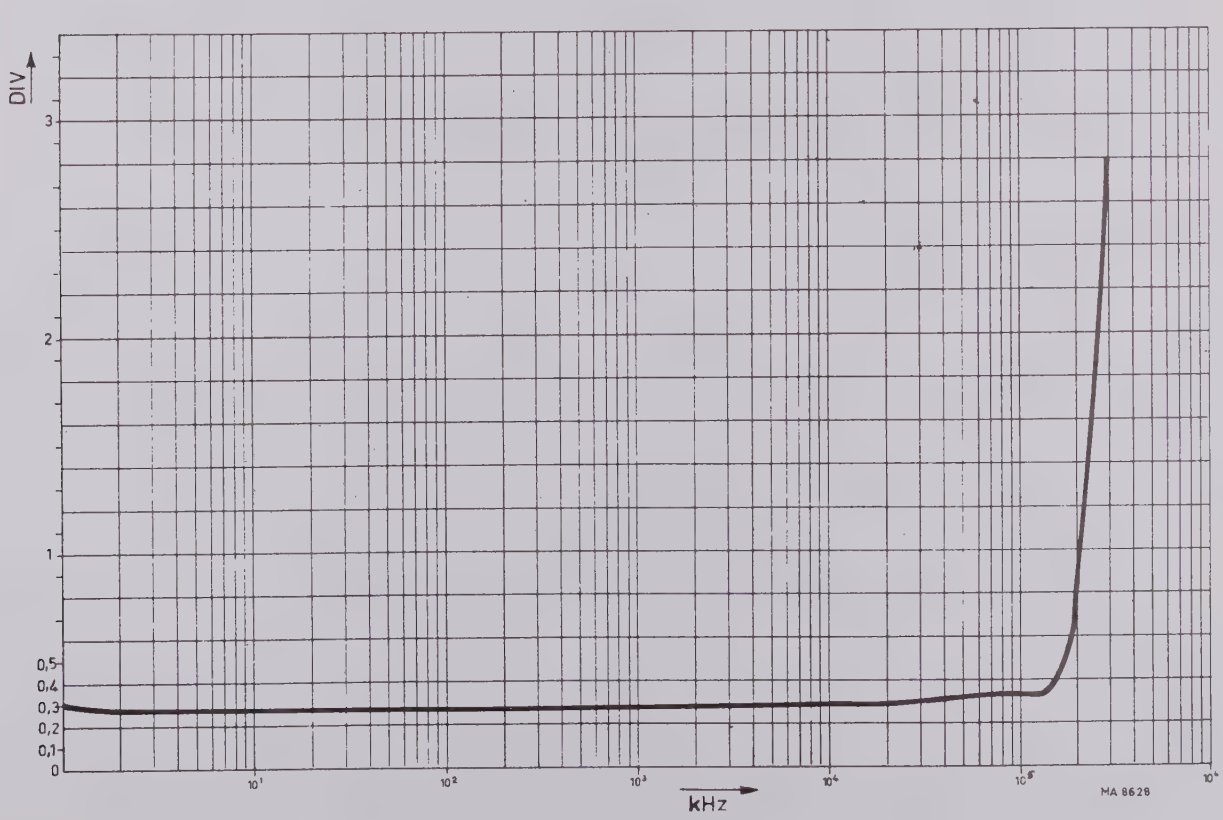


Fig. 1.3. Typical trigger sensitivity of channel A as a function of frequency

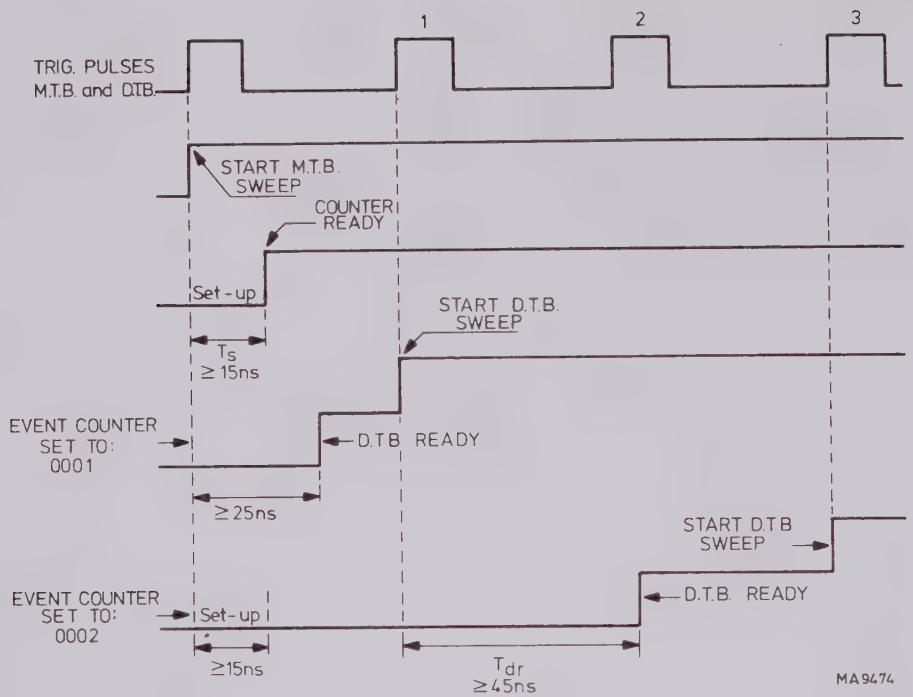


Fig. 1.4. Most critical sistuation of Digital Delay triggering.

Example for pulse repetition time of 40 ns (freq. 25 MHz).
Same trigger pulse for main- and delayed time-base.

Limit Conditions:

1. True counting starts after "set-up" time of ⩾ 15 ns after triggering of Main Time-base.
2. EVENT counter set to "0001": The Delayed time-base is ready ⩾ 25 ns after Main time-base triggering.
3. EVENT counter set to "n": The Delayed Time-base is ready ⩾ 45 ns after pulse "n −1".
4. Counting is correct till frequencies upto ⩽ 22 MHz.

2. Directions for use

2.1. INSTALLATION

Front cover

Removing:
– Turn the knob in the centre of the cover a quarter of a turn counter-clockwise.
– Take the cover off.

Fitting:
– Align the key of the locking knob with the slot in the text plate of the instrument.
– Fit the cover over the front of the oscilloscope.
– Press the knob and turn it a quarter of a turn clockwise.

The room in the front cover is available to accommodate accessories such as probes, collapsible viewing hood.

To open the front cover press both tongues of the locking device and lift the inner plate.

The handle can be rotated if the push-buttons on its bearings are depressed.

Mains adjustment and fuse

The ability of the instrument to operate at any line voltage between 90 and 270 V a.c. or between 100 and 200 V d.c. obviates the need of adaption to the local line voltage.
The fuse holder is mounted on the rear panel. The 2 A delayed action fuse is used at all line voltages.
Make sure that only fuses with the required rated current and of the specified type are used for replacement.
The use of mended fuses and the short-circuiting of fuse holders shall be avoided. The instrument shall be disconnected from all voltage sources when a fuse is to be replaced.

WARNING : This instrument generates high voltages and should not be operated with the cabinet plates removed.
The line plug must be removed before attempting any maintenance work.
Before any other connection is made, the protective earth terminal shall be connected to a protective conductor (see section *Earthing*).

Earthing

Before switching on, the instrument shall be connected to a protective earth conductor in one of the following ways:

– Via the protective earth terminal (identified by the symbol ⏚).
– Via the three-core line cable. The line plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension cord without protective conductor.

WARNING : Any interruption of the protective conductor outside or inside the instrument or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

When an instrument is brought from a cold into a warm environment, condensation may cause a hazardous condition. Therefore, make sure that the earthing requirements are stricktly adhered to.

Dismantling

The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and also accessible terminals may be live.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened.

If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is award of the danger involved.

Replacing the mains plug is at the user's own risk. After replacing a mains plug, a high-voltage test in accordance with IEC Publication 348 is strongly recommended.

Bear in mind that capacitors inside the instrument may still be charged, even if the instrument has been separated from all voltage sources.

Switching on

The POWER switch is incorporated in the graticule ILLUMination control on the front panel, immediately below the screen bezel.

Fig. 2.1. Removing the front cover

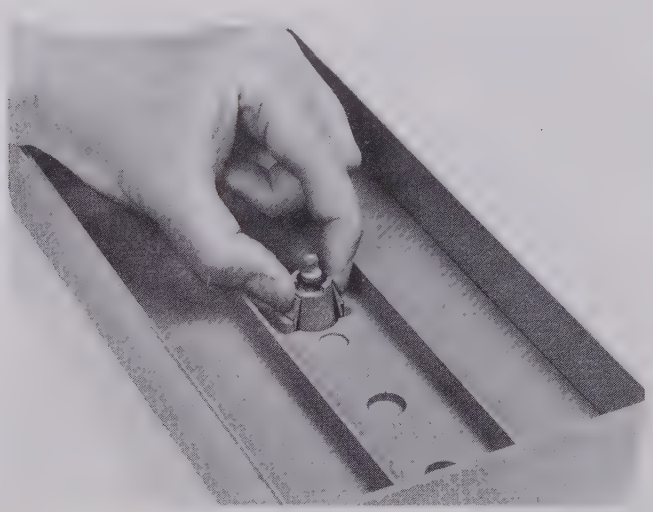


Fig. 2.2. Opening the front cover

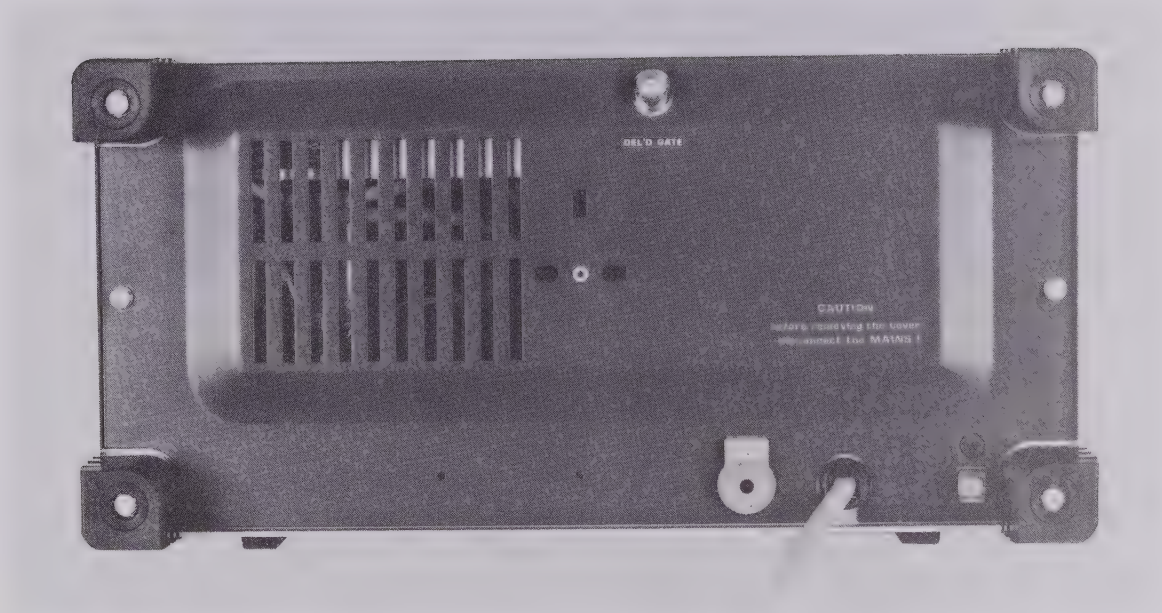


Fig. 2.3. Rear view

2.2. FUNCTION OF CONTROLS AND CONNECTORS

Vertical Deflection

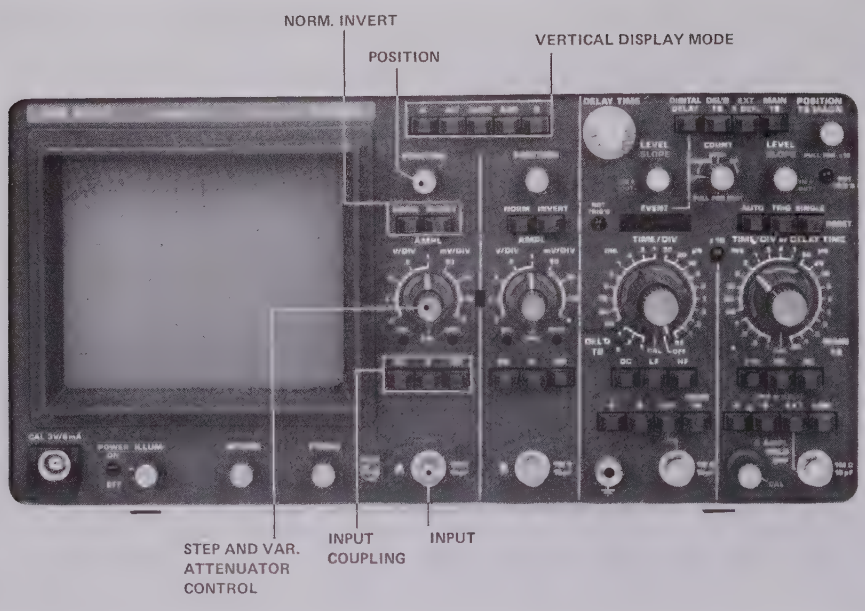


Fig. 2.4. Vertical Deflection

VERTICAL DISPLAY MODE

A	- channel A only.
ALT	- channels A and B alternately displayed.
CHOP	- channels A and B chopped displayed.
ADD	- channels A and B algebraically added.
B	- channel B only.

If no button depressed, channel A is on.

POSITION

Continuously variable control giving vertical shift of the relevant channel.

NORM-INVERT

This switch facilitates inverting of the input signal polarity.

STEP AND VARIABLE ATTENUATOR CONTROL

AMPL/DIV	Step control of the deflection coefficients, combined with :
CAL	Continuous variable control of the deflection coefficients. In the CAL position the deflection coefficient is calibrated.

INPUT COUPLING

AC	— Signal coupling via a blocking capacitor.
O	— Input connected to earth; signal-load open.
DC	— Direct coupling.

(if no button is depressed, the AC condition is on).

PRESET CONTROLS

BAL	Step attenuator balance compensation
GAIN	Step attenuator amplitude calibration.

Horizontal Deflection

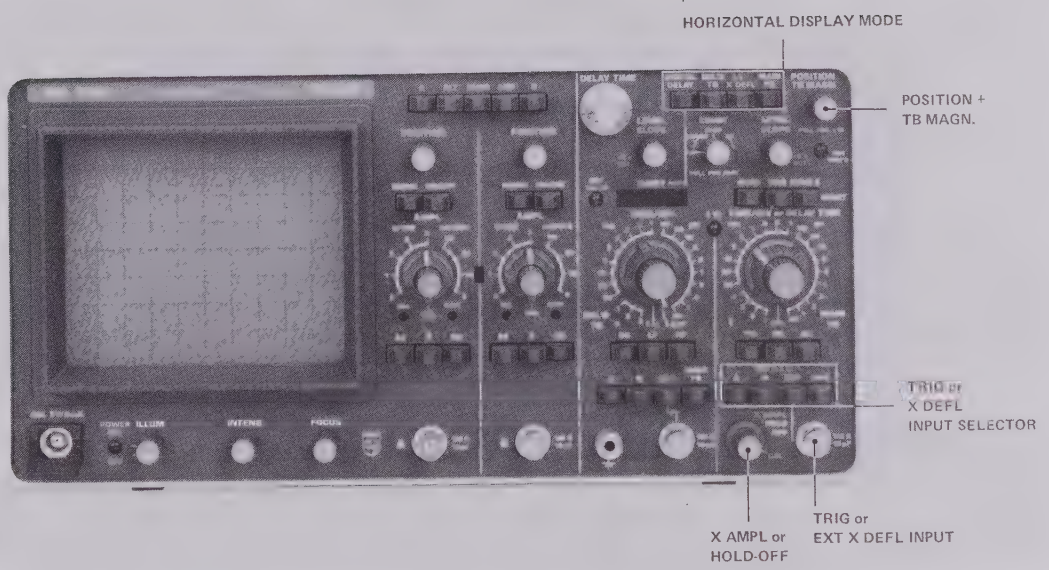


Fig. 2.5. Horizontal Deflection

HORIZONTAL DISPLAY MODE

MAIN TB	The horizontal deflection is provided by the main time base generator. A part of the display is intensified when the delayed time base is on.
EXT X DEFL	Horizontal deflection is achieved by an external signal coming from: – Input socket of the horizontal amplifier, or – One of the vertical deflection channels or – The line.
DEL'D TB	The horizontal deflection is provided by the delayed time base generator.
DIGITAL DELAY	Digital delay operative

(if no button is depressed, the main tb is on).

POSITION + TB MAGNIFIER

POSITION	Continuously variable control giving horizontal shift of the display
TB MAGN	Push-pull switch which increases the time-base coefficients by a factor of 10. Not operative in the EXT X DEFL. mode.

TRIG or X DEFL. INPUT SELECTOR

MTB trigger source selector, or horizontal deflection source selector in the EXT X DEFL. mode.

A	- source : ch. A
B	- source : ch. B
EXT	- source : EXT via EXT input socket
LINE	- source : line voltage (mains)

TRIG or EXT X DEFL. INPUT

Input socket to apply the external trigger or horizontal deflection voltage.

X AMPL or HOLD OFF

This knob permits control of the horizontal deflection amplitude in case of EXT X DEFL. If the MAIN TB has been selected for horizontal deflection this knob permits control of the hold-off time.

Main Time Base

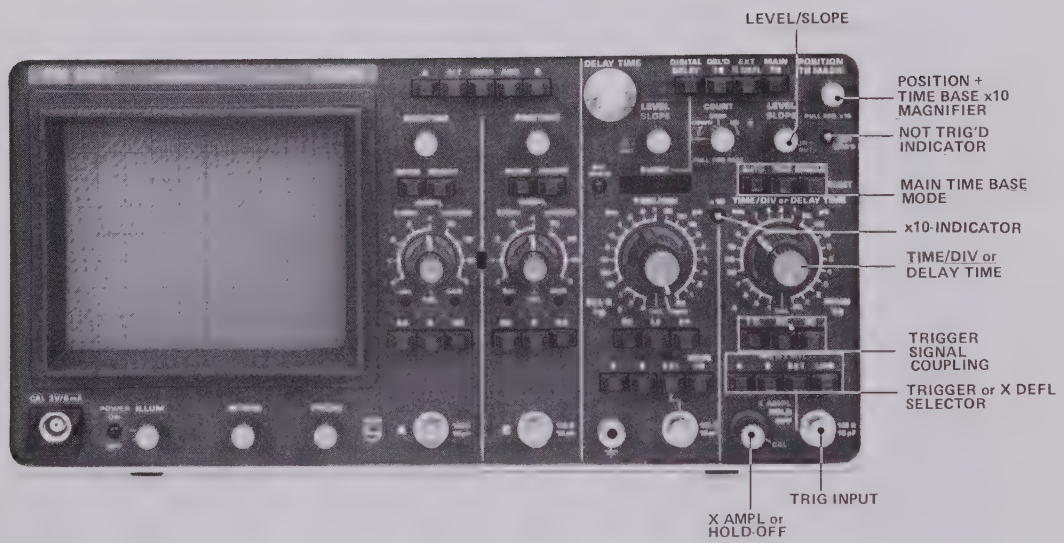


Fig. 2.6. Main time base

MAIN TIME-BASE MODE

AUTO	The main time-base is free-running when no trigger pulses are present.
TRIG	The main time-base is normally triggered.
SINGLE	Single sweep time-base. After operating the SINGLE button, the main time-base generator runs only once upon receipt of a trigger pulse. (if no button is depressed the time-base is in the single sweep mode).

TIME/DIV or DELAY TIME

Step and continuous control of the main time-base sweep coefficients; 23-way rotary switch.

If the normal delayed time-base mode is used, the delay time after which the delayed time-base starts, is the product of the DELAY TIME calibrated dial setting and the TIME/DIV setting of this switch.

Only in the CAL position of the continuous control the sweep coefficients are calibrated.

LEVEL/SLOPE

Continuously variable control to select the trigger level at which the time-base generator starts.
The push-pull switch enables choice of triggering on the positive- or negative-trigger going slope of the signal.

TRIGGER SIGNAL COUPLING

TTL	Main time-base triggers on TTL logic level The LEVEL control is not operative.
DC	Main time-base trigger is sensitive over the whole bandwidth (d.c. . . . 120 MHz).
AC	Main time-base trigger is sensitive only for a.c. signals (20 kHz ... 120 MHz).

TRIGGER or X DEFL. SELECTOR

If the instrument is used in the time-base mode, the main time-base can be triggered by :

A	Signal taken internally from channel A
B	Signal taken internally from channel B
EXT	Signal applied to the trigger input socket
LINE	Line voltage (mains) internally connected.

TRIG INPUT

Input socket for applying an external trigger signal.

POSITION, TIME BASE MAGNIFIER

Continuous horizontal shift control. If the knob is pulled the time-base sweep speed is multiplied by 10 (indicated by the X10 pilot lamp.)

NOT TRIG'D INDICATOR

Lights up when the time-base generator is not triggered.

X AMPL or HOLD OFF

Controls the hold-off time of the main time-base generator.
In the EXT X DEFL. mode the horizontal deflection amplitude can be varied.

Delayed Time Base

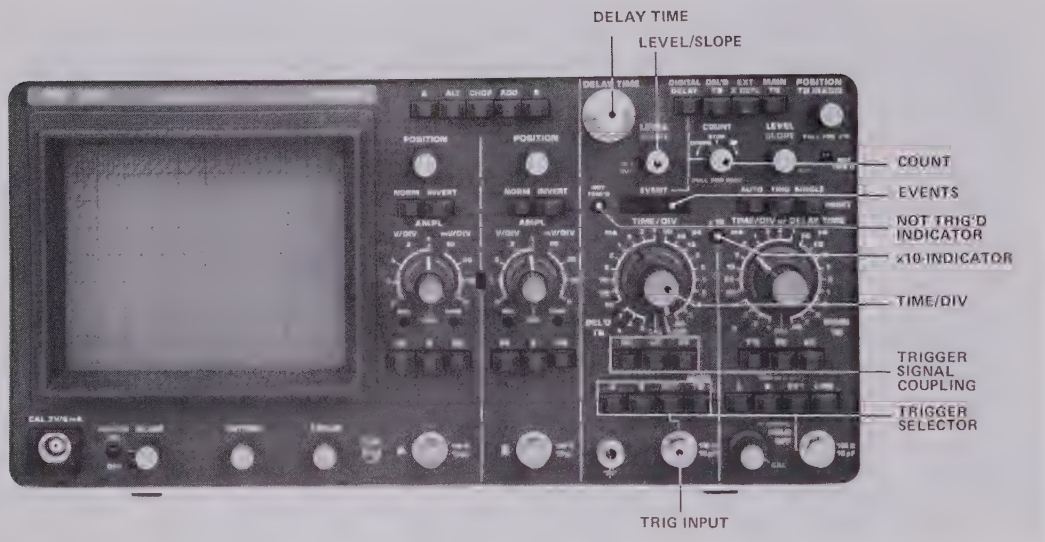


Fig. 2.7. Delayed time base

TIME/DIV

Step and continuous control of the delayed time-base sweep coefficients; 22-way rotary switch with additional OFF position.

Only in the CAL position of the continuous control the sweep coefficients are calibrated.

DELAY TIME

If the normal delayed time-base is used the delayed time-base atarting point, is the product of the DELAY TIME multiplier setting and the selected TIME/DIV value, at the main time-base TIME/DIV control.

LEVEL/SLOPE

Continuously variable control to select the trigger level at which the delayed time-base generaotr starts. The push-pull switch enables choice of triggering on the positive- or negative-trigger going slope of the signal.

TRIGGER SIGNAL COUPLING

Selection of the frequency-depending sensitivity of the delayed time-base trigger circuit.

DC	Full bandwidth (d.c. ... 120 MHz).
LF	Low frequnecy (10 Hz ... 20 kHz). Any influence of h.f. noise signals is then suppressed.
HF	High frequency (20 kHz ... 120 MHz). To suppress any influence from l.f. signals e.g. hum.

TRIGGER SELECTOR

Selects the trigger source for the delayed time-base.

A	- Signal taken internally from channel A
B	- Signal taken internally from channel B
EXT	- Signal which is applied to the trigger input socket.
MAIN TB	- The delayed time-base starts immediately after de delay time (in the normal delayed time-base mode). This switch overrides the DIGITAL DELAY switch.

TRIG INPUT

Input socket for applying an external trigger signal.

POSITION, TIME BASE MAGNIFIER

Continuous horizontal shift control. If the knob is pulled the time-base sweep speed is multiplied by 10 (indicated by the X10 pilot lamp).

NOT TRIG'D INDICATOR

Lights up when the delayed time-base generator is not triggered.
Indicates that the number of pulses to be counted exceeds the number of pulses that is shown on the c.r.t. (wrong setting of time-base combination).

COUNT

This knob controls the EVENT display contents, thus determining the number of pulses to be counted.
Turning the knob from the centre-stop to the right increases the number of pulses to be counted.
Turning the knob from the centre-stop to the left decreases the number of pulses to be counted.
The c-character in the display indicates that the contents is changing.
In the centre-stop position of the knob the display contents remain constant.

EVENT

Four bit, 7 segment led display showing the number of pulses to be counted to trigger the delayed time-base.
The display is blanked if the digital delay is not operative.

C.r.t. display section

POWER/ILLUM	Continuously variable control for the graticule illumination combined with power on-off switch. Pilot lamp indicates the ON state.
INTENS	Continuously variable control of the display-brightness.
FOCUS	Continuously variable control of the electron-beam focussing.
CAL	Output socket for calibration of: – The gain of the vertical deflection amplifier and, – The frequency compensation of attenuator probes. Suited for voltage probes and current probes.

Rear Side (refer to Fig. 2.3).

DEL'D GATE	TTL compatible delayed time-base gate output. "High" during main time-base intensified, and delayed time-base running times.
2 AT	2 Amps slow-blow line fuse; for all line voltages

Mains cord and protective earth terminal (⏚).

2.3. PRELIMINARY SETTINGS

Before measurements with this oscilloscope are carried out, check that the step-attenuator balance and the gain calibration for each channel are well adjusted.
If necessary proceed as follows:

1. Adjusting the step attenuator d.c. balance.
   —Depress the MAIN TB button of the horizontal deflection mode switch.
   —Depress the AUTO button of the main time-base mode switch.
   —Set the INTENSITY and FOCUS controls for a sharp, well-defined trace.
   —Depress the relevant channel button of the vertical deflection mode switch.
   —Depress the 0 button of the input coupling switch.
   —Set the POSITION knob so that the trace is somewhere about in the centre of the screen.
   —Set the AMPL. continuous control at position CAL.
   —Check that the trace does not jump when the AMPL. switch knob is rotated
   If necessary adjust the BAL control.

2. Gain calibration.
   Unless otherwise stated, the controls occupy the same positions as in the previous procedure.
   —Set the AC-0-DC switch to AC.
   —Set the AMPL. switch knob to .5 V and continuous control to CAL.
   —Connect the channel input to the CAL output.
   — Check that the vertical deflection is exactly 6 divisions.
   If necessary adjust the GAIN control.
   — Als an attenuator probe can be included in this calibration. The probe attenuation factor must then be taken into account with respect to the APML. switch position.

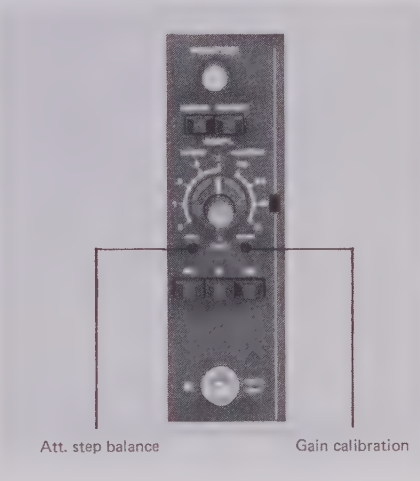


Fig. 2.8.

2.4. OPERATING INSTRUCTIONS

General

Before switching-on, ensure that the oscilloscope has been correctly installed in accordance with the INSTALLATION recommendations (Chapter 2.1.) and that the precautions outlined have been observed.

Vertical deflection

To display the desired channel, depress the corresponding button of the vertical mode switch. If two traces need to be displayed, the display can be either in the alternate- or in the chopped mode.
In the alternate mode, the channels are displayed successively; during flyback of the time-base sweep the display is switched-over from one channel to the other. In the chopped mode, the channels are successively switched from one to the other during the time-base sweep. The display time in the chopped mode is approx. 500 ns per channel.
To obtain a steady display the alternate mode is generally used at the higher sweep speeds and the chopped mode at the lower speed speeds.

The signals under observation are fed to input sockets A and B and the AC/0/DC switch is set to either AC or DC, depending on the composition of the signal. As the vertical amplifiers are d.c. coupled, the full bandwidth of the instrument is available and d.c. components are displayed as trace shift in the DC position of the AC/0/DC switch.
This may be inconvenient when small signals superimposed on high d.c. voltages must be displayed. Any attenuation of the signal will also result in attenuation of the small a.c. component. The remedy is to use the

AC position of the input switch, which employs a blocking capacitor, to suppress the d.c. component. Some pulse droop, however, will occur when l.f. squarewave signals are displayed.

The 0 position interrupts the signal path and earths the amplifier input for quickly determining the 0 V level. The position controls permit the display to be shifted in the vertical direction.

Horizontal deflection

Depending on the horizontal display switch, the horizontal deflection source can be:

- Main time-base
- Ext. X defl.
- Delayed time-base

The fourth switch - Digital Delay - makes the event counter of the delayed time-base operative.

With the position control, combined with the time-base magnifier, the display can be shifted in the horizontal direction.

If the MAIN TB or DEL'D TB button is depressed the horizontal deflection is effected by the main time-base or the delayed time-base respectively.
If the EXT X DEFL button is depressed the horizontal deflection can be taken from:

- One of the vertical deflection channels A, B, C or D
- Line voltage (mains)
- Externally via EXT connector

The time-base magnifier is not operative in the EXT X DEFL mode.

Main time-base

Linear horizontal deflection is obtained when the MAIN TB button of the horizontal display switched is depressed.
The time-base mode can be chosen by the time-base mode switch :

AUTO — Time-base is running, even if no trigger pulses are present. The trace is, therefore, always visible. The AUTO mode can be used in all cases where the TRIG mode is also valid, except with signal frequencies lower than 10 Hz, or pulse trains with an off-time exceeding 100 ms. As soon as trigger pulses are present, the free-running state of time-base is automatically terminated and the time-base generator is normally triggered.

TRIG — The time-base is visible when trigger pulses are present, and trigger-level control is correct.

SINGLE — The time-base makes only one sweep after receipt of a trigger pulse. After this sweep the time-base must be reset by again depressing the SINGLE button. When effects that occur only once have to be observed (usually photographed), it is often desirable to ensure that only one sweep is generated even though several trigger pulses might be produced after the phenomenon of interest.

The sweep times of the main time-base are set with the TIME/DIV or DELAY TIME knob. With the centre knob, time-base sweep times between the steps can be adjusted. For time measurements this knob must always be in the CAL position. The TIME/DIV coefficient of the time-base can be increased by a factor of 10, by pulling the TB MAGN push-pull knob.
The normal position of the HOLD OFF control is fully clockwise. By turning the control anti-clockwise, the hold-off time is extended.
With the HOLD OFF control, the hold-off time of the main time-base generator can be varied. This is the time needed by the time-base generator to be ready for receipt of the next trigger pulse. The HOLD OFF control permits steady display of more complicated signals e.g. periodic double-pulses.

Main time-base triggering

To obtain a stable display, the time-base sweep must always be started on one fixed point of the signal. The time-base generator is, therefore, started by trigger pulses that are derived from the following signals, depending on the main time-base trigger selector switch :

– channel A
– channel B
– external voltage, applied to the corresponding input socket
– line voltage (mains); the coupling with the line voltage is obtained by a built-in opto-isolator circuit, hence the instrument remains isolated from the line voltage.

With the LEVEL control, the point of triggering on the slope of the signal can be chosen.
The SLOPE push-pull switch permits selection of the positive- or negative-going slope.

If the main time-base generator receives no trigger pulses, the NOT TRIG'D indicator lights up.
In the SINGLE sweep mode this indicator lights up if the time-base generator has been reset and is waiting for the next trigger pulse.

Three means of trigger coupling can be selected by the trigger mode switch :

– TTL The main time base trigger circuit is now adopted for automatic triggering on TTL signals. The level control is not operative.

– DC The main time-base trigger circuit is sensitive over the whole bandwidth from d.c. upwards.

– AC The main time-base trigger circuit is sensitive for a.c. signals only. The d.c. components of the trigger signal is blocked.

Delayed time-base

If the MAIN TB button of the horizontal display switched is depressed, and the delayed time-base TIME/DIV knob is not in the OFF position, part of the main time-base sweep line is displayed at higher intensity.
In this way, part of the displayed signal can be selected for more detailed observation. The selected part of the signal is displayed over the whole screen by pressing the DEL'D TB switch.
The sweep time of the intensified part of the main time-base sweep depends on the delayed time-base TIME/DIV knob.
With the centre knob, sweep time between the steps can be adjusted. For time measurements this knob must always be in the CAL position.

a. *Normal Delay*

In this mode the DIGITAL DELAY switch is not depressed.
The exact starting time of the delayed time-base is determined by the settings of the main time-base TIME/DIV or DELAY TIME knob and the DELAY TIME 10-turn multiplier knob.

If the MAIN TB trigger selector switch of the delayed time-base is pressed, the delay time after which the delayed time base is started, is the product of the main time-base TIME/DIV switch setting and the DELAY TIME multiplier knob.

If instead of MAIN TB , the delayed time-base is triggered by A, B or EXT, the delayed time-base will start after this delay-time and upon receipt of a trigger pulse.

b. *Digital Delay*

This mode is operative if the DIGITAL DELAY knob is depressed. The DELAY TIME multiplier is now inoperative. The delayed time-base is started after counting a pre-set number of events, which are applied to the delayed time-base trigger circuit. This number of events is shown on the EVENTS display.
The number of events to be counted can be controlled by the COUNT knob.
The trigger pulses (events) can be taken internally from channel A or channel B, or externally via the EXT input.

For both Normal- and Digital Delay, trigger pulse-level and slope control is possible. With the LEVEL control the point of triggering on the slope of the signal can be chosen. The SLOPE push-pull switch permits selection of the positive- or negative-going slope.

Note, when operating at high counting frequencies, it may be necessary to take the following measures to prevent any instability in counting.

– Select different polarity settings of the Main time-base and Delayed time-base SLOPE switches.

– Adjust carefully both Main time-base and Delayed time-base LEVEL controls.

2.5. FULL FIVE DIGITS DISPLAY MODIFICATION

The standard PM 3261 EVENT display consists of four digits with a "c" for count at the fifth most significant bit location.

If desired the EVENT display circuit can be arranged to show five full digits giving a maximum count of 99.999. The "c" indication is then omitted, but instead of, the count action is indicated by the decimal points in the display.
Because of the higher number of counting also the fast display setting oscillator frequency is increased.

Required components:

- 1x SN74LS190B (16 p. DIL I.C.)
- 1x F93S10PC (16 p. DIL I.C.)
- 1x capacitor 0,22 μF, 63 V, 15 mm pitch

Proceed as follows:
Refer also to Fig's 2.9, 2.10 and 2.11.

- Remove the digital delay unit
- Remove the solder from soldered link A at the upper side of the unit.
- Remove the solder from both soldered links B at the bottom side of the unit.
- Add solder on link C at the bottom of the unit.
- Insert the two digital I.C.'s in addition to the corresponding rows.
- To increase the display setting oscillator frequency replace the 1 μF capacitor (C2203) by a 0,22 μF model.
- Remount the unit.

The display unit, located at the front panel, needs no modification.

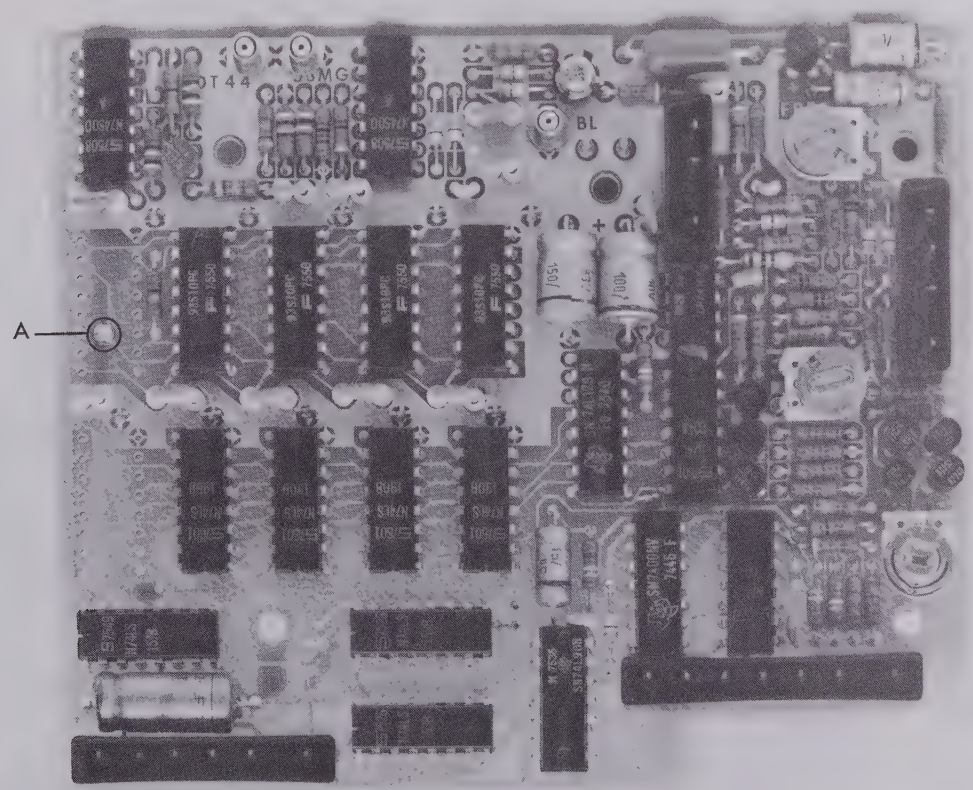


Fig. 2.9. Top view digital delay unit

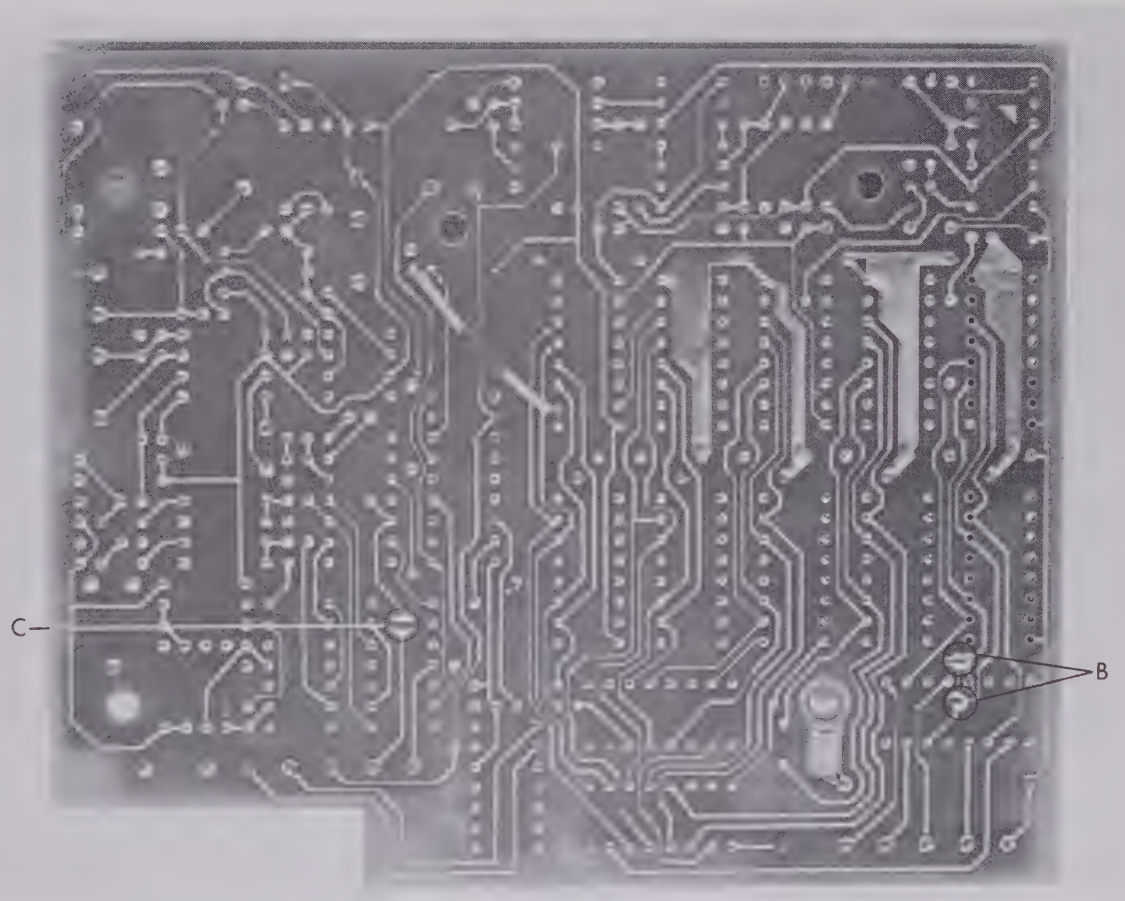


Fig. 2.10. Bottom view digital delay unit

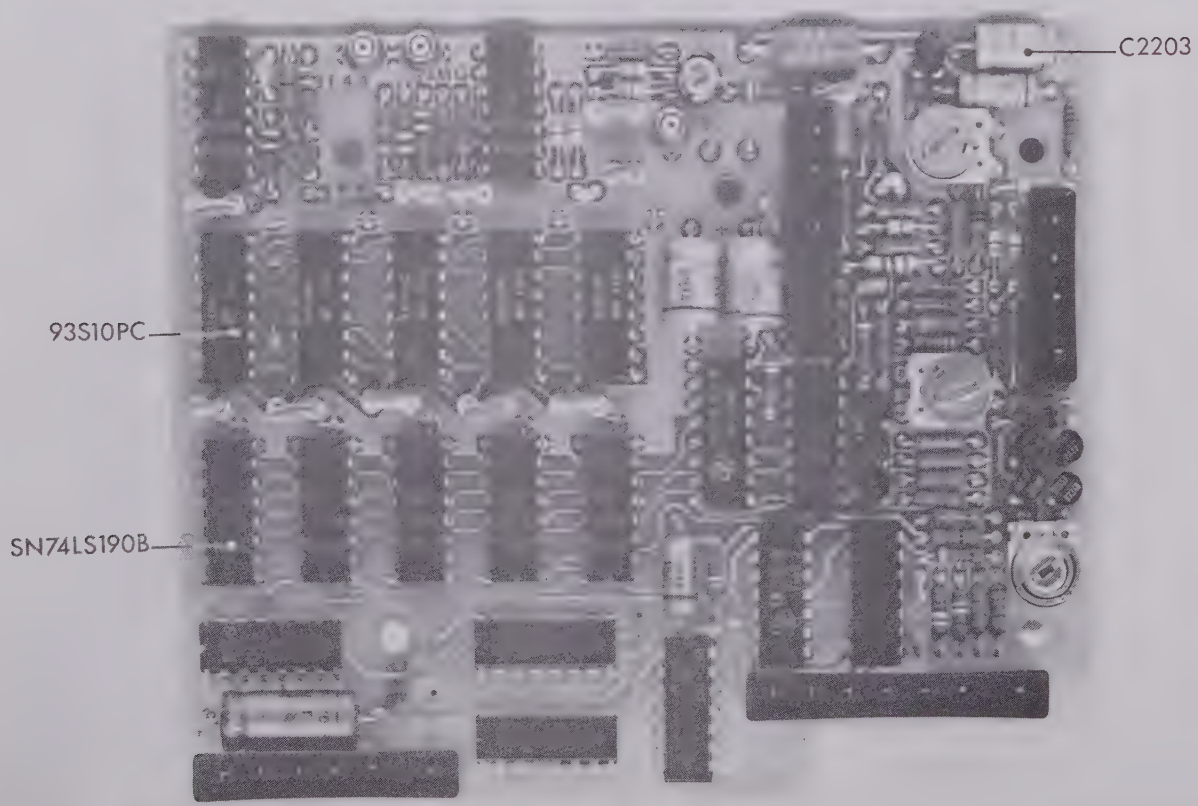


Fig. 2.11. Digital delay unit after five full digit arrangement.

3. Service manual

3.1. DESCRIPTION OF THE BLOCK DIAGRAM (Fig. 3.1.)

3.1.1. General information

The PM 3261 oscilloscope comprises the following parts:

- a dual-channel vertical system
- a main time-base
- a delayed time-base
- a counter unit
- a display unit
- a switching unit
- an X amplifier
- a Z amplifier
- a c.r.t. circuit
- a stabilized power supply.

3.1.2. Dual-channel vertical system

Both vertical channels contain identical circuits. An input signal to one of the channels is, via a coupling switch AC/0/DC, applied to the input attenuator. In the AC position of the coupling switch there is a capacitor in the signal path. In the DC position the coupling is direct.
If the coupling switch is set to the 0 position, the connection between the input socket and the attenuator input is interrupted, the latter being earthed.

The input attenuator, which is controlled by the AMPL switch, enables the adjustment of the vertical-deflection sensitivity in calibrated steps.

The attenuator is followed by a low-drift impedance converter which gives the input circuit a high input impedance.
The impedance converter also contains a voltage divider which works in conjunction with the input attenuator. The d.c. balance of the entire channel is set by compensating for the d.c. offset voltage of the impedance converter by means of the BAL potentiometer.

The signal that leaves the impedance converter on a 50 Ohm level is applied to a paraphase amplifier where it is transformed into a push-pull signal. The paraphase amplifier has two outputs. From one of these outputs the signal is applied to a trigger pre-amplifier and from the other one to an amplifier stage. This stage comprises the switch NORMAL/INVERT by means of which the phase of the signal can be inverted, and a GAIN pre-set potentiometer which allows the overall gain of the channel to be set.

The following stage is a channel selector which either blocks or passes the signal as dictated by the channel selector logic. The channel selector also comprises the controls for vertical trace positioning.
In the A, B and ADD modes the channel selector logic is set by means of voltage levels and in the ALT and CHOP mode controlled by pulses. In the ALT mode those pulses are supplied by the sweep-gating multivibrator of the main time-base generator during the flyback of the sweep, so that alternately the complte signals of channel A and channel B are displayed.
In the CHOP mode the drive pulses are provided by an oscillator which works at a fixed frequency of approximately 1 MHz.
Those pulses cause the electronic switches in the channel selector to be successively opened and closed so that successively part of the signal of channel A and of channel B are displayed.

After the channel selector, the following circuits are common to both vertical channels.
A delay line that delays the vertical signals to such an extent that the steep leading edges of fast signals are still displayed, a correction circuit in which the losses caused by the delay line are compensated for, and a final output stage which feeds the signals to the vertical-deflection plates.

3.1.3. Time bases

3.1.3.1. Main time-base

The trigger source/X deflection selector receives its signal from one of the vertical channels, from the attenuator/impedance converter for external trigger or X deflection signals, or from the power supply (LINE). One of those signals can be selected by operating one of the controls incorporated in this stage.

From the selector stage the signal is fed to either the X amplifier for horizontal deflection, or the trigger amplifier for starting the time-base generator. The amplifier is a differential one, containing the controls for trigger-level adjustment, slope selection and coupling selection. By means of the coupling selection the input circuit can be adapted for TTL, DC or AC triggering. The slope selector allows the polarity of the trigger signal to be inverted, enabling triggering on the positive as well as on the negative slope of the input signals.

From the amplifier the trigger signal is applied to the trigger pulse shaper that supplies well-defined trigger pulses. These trigger pulses are used to switch the sweep-gating multivibrator and, when the AUTO push-button has been operated, for driving the automatic circuit.

The sweep-gating multivibrator starts and stops the integrator which delivers the sawtooth signal required for the horizontal deflection. The integrator comprises the charging capacitors and resistors selected by the TIME/DIV switch in order to set the time coefficients in calibrated steps. Continuous control of the time coefficients is obtained by varying the charging current of the time determining capacitors by means of the TIME/DIV potentiometer.

The amplified output signal of the integrator is fed to the X-deflection selector, the hold-off multivibrator and the comparator which is part of the delayed time-base unit. The hold-off multivibrator switches back the sweep-gating multivibrator and blocks its input during the flyback of the sawtooth signal. The hold-off circuit also incorporates the single-sweep circuit which causes the main time-base to deliver only one sawtooth pulse, after the SINGLE button has been depressed and upon receipt of a trigger pulse.

The automatic free-run circuit or auto-circuit makes the time-base generator free-running when there are no trigger pulses.

3.1.3.2. Delayed time-base

The delayed trigger-unit and time-base generator comprise in principle the same circuitry as the main trigger-unit and time-base generator. The delayed time-base works always in the single-shot mode. It is started by the main-time-base generator which also serves as hold-off circuit for the delayed time-base.

There are two trigger modes:

a. The standard triggering as in the basic PM 3260 oscilloscope.
   The moment of triggering of the delayed time-base is determined by the product of the delay time multiplier knob and the main time base time/div. switch.
   The delayed time-base can be started automatically after the delay time (trigger function MAIN TB), or can be triggered after the delay time by the channel A, B or EXT signal.

b. Digital delay mode.
   The delayed time-base is now triggered after counting a certain number of delayed time-base trigger pulses, which are counted-down by the fast counter.
   The fast counter has been preset with a certain decimal number controlled by the up/down counter and indicated by the 7-segment display at the frontpanel.
   At the moment that event nr. n-1 has been counted the delayed time-base generator is set ready to trigger on the next pulse.

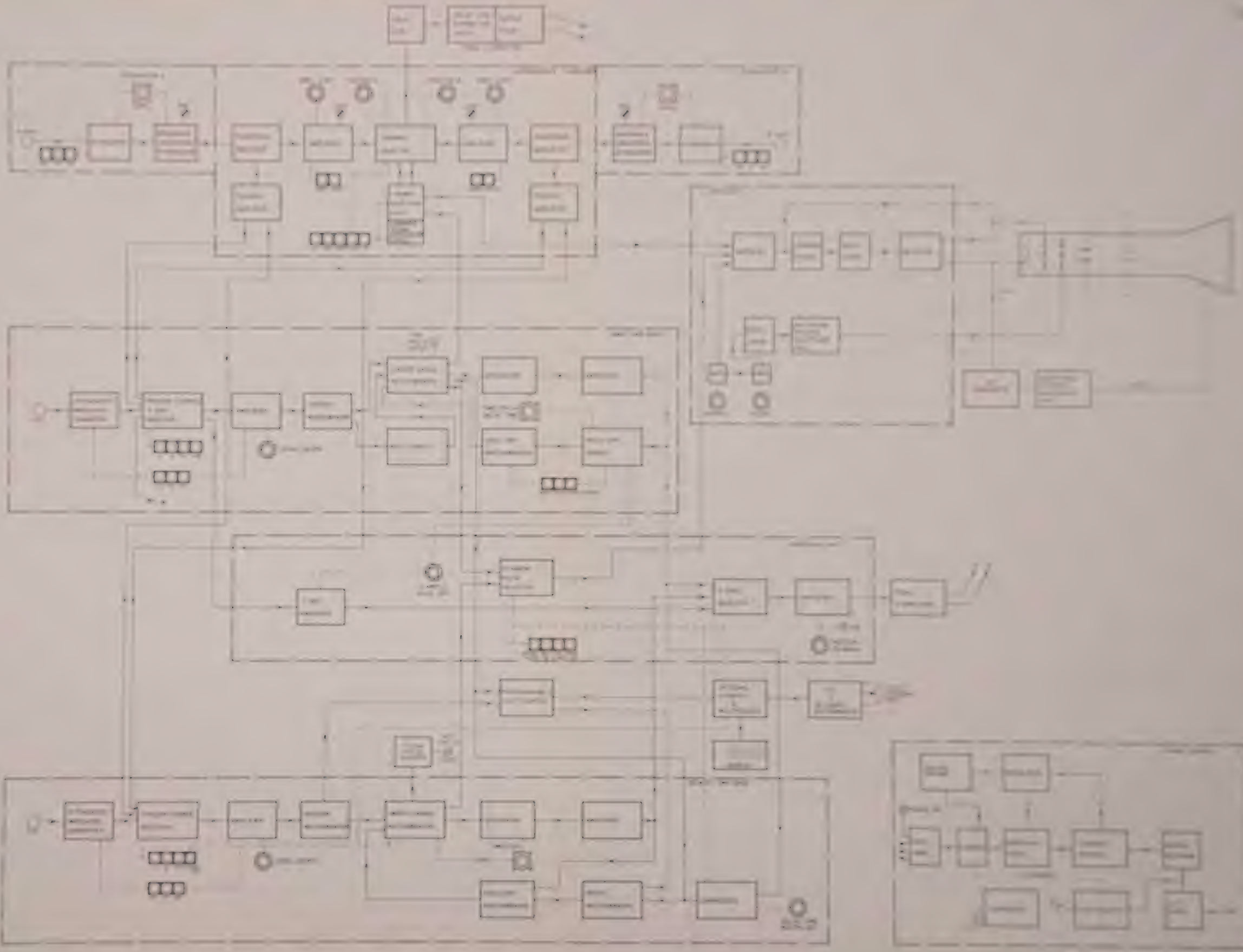
When push-button MAIN TB of the horizontal deflection mode controls has been depressed, the part of the trace coinciding with the delayed sweep is intensified, except in the OFF position of the delayed TIME/DIV switch.

3.1.3.3. Description of the block diagram of the digital delay unit (Fig. 3.2.)

The digital delay is placed on two printed circuit boards.
How the blocks are devided over these two PCB's is indicated in the block diagram. The shaded areas in the block diagram indicate parts that are in use in case of a fifth counting digit.
Moreover there are 3 soldering bridges that are open or closed depending on the 4 or 5 digit situation.

Basically the block diagram may be split up into 3 functions:

a. An up/down counter, which can be preset with the pulses from a voltage controlled oscillator.
b. A high speed counter, which is loaded with the contents of the up/down counter. It counts the DTB count pulses and enables the DTB in the end of count state to trigger on the next trigger pulse.
c. To display the number of pulses after which the DTB triggers some blocks for multiplexing, conversion and decoding are used.



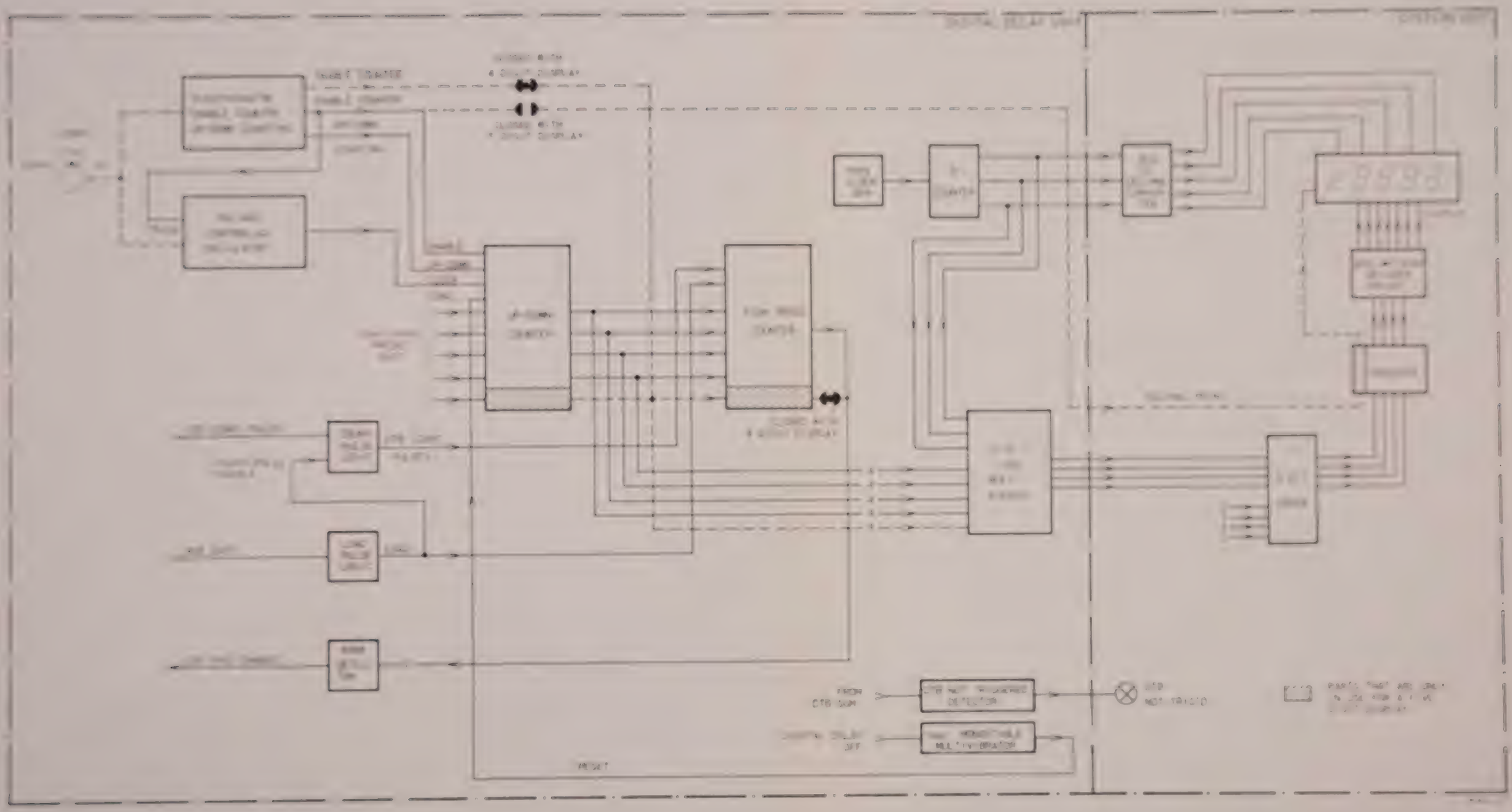


Fig. 3.2. Block diagram of the digital delay unit

The COUNT control is the only control of this unit. It is a potentiometer with a push-pull switch and a mid lock position. It has the following functions:

- Start counting: as soon as the control is turned away from its mid position (= STOP) the counting starts and the display changes.
  Moreover the first decade of the display shows the count sign (/‾).
  In case of a five digit counter the decimal points in the display light up.
- UP/DOWN counting: turning the control clockwise out of its mid position gives an increasing number in the display, turning it anticlockwise decreases the number.
- counting speed: the more the control is turned away from its mid position, the faster the display changes.

The first two functions mentioned above are detected by the block "discriminator enable counter + up/down counting". If the count control leaves its mid position the "enable counter output" becomes low to enable the block "up/down counter" to count. This block also has an inverted "enable counter" output. The up/down output makes the up/down counter count respectively up or down.
The third function of the control is achieved by the block "voltage controlled oscillator". The oscillator-frequency depends on the position of the count control potentiometer and the selected frequency range, which is selected by the push pull switch. The two ranges are: slow (0,5 Hz to 60 Hz) and fast (15 Hz to 1500 Hz).

The up/down counter consists of 4 (or 5 in case of 5 counting digits) BCD up/down counters. If the digital delay is switched off, the counter receives a 1 second load pulse from "the 1 second monostable multivibrator" block and is loaded with a preset number.
A load command also appears if the oscilloscope is switched on.
This number is 9998 which is converted into its nine's complement by means of the blocks "4 bit adder", which adds 6 in BCD, and the "4 bit inverter". This nine's complement feeds the display which now shows the number 0001. This conversion is explained in the following table:

Number in up/down counter	decimal	9	9	9	8
	BCD	1001	1001	1001	1000
6 in BCD		0110	0110	0110	0110
BCD number after addition		1111	1111	1111	1110
BCD number after inversion		0000	0000	0000	0001
Decimal number in display		0	0	0	1

Table showing conversion decimal into BCD:

decimal	0	1	2	3	4	5	6	7	8	9
BCD	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001

The use and the advantage of this conversion is explained later on.
Some more examples of nine's complement conversion:

9997 becomes 0002, 9996 becomes 0003, 5000 becomes 4999, 0002 becomes 9997, 0001 becomes 9998 and so on. So if the display counts down, the counter counts up and vice versa.

To save logic for conversion and to reduce connecting cables between the two P.C.B.'s of the delay, the 5 digits in the display light up one by one by means of time multiplexing. To achieve this, the signal of the "1 kHz clock generator" drives a block called "5 counter", which counts from 0 to 4 in BCD. This three bit code is fed into the "BCD to decimal converter" block, which has 5 outputs. These outputs become one by one low depending on the BCD input code. Every output activates one digit of the "display" block.

The digits are of the 7 segment type. It is necessary to activate the proper segments in the selected digit, to compose the desired sign.
The information about the desired sign is given in a 4 bit BCD code, which has to be converted to drive the segments in the right way.
The block "BCD to 7 segment decoder driver" makes this possible.
The information this block receives, is the already explained nine's complement of the counter contents.
As the digits of the display light up one by one, it is necessary that the adder's inputs are connected with the proper outputs of the up/down counter. Because there are 5 digits with 4 BCD coded bits each, 4 multiplexers

with 5 inputs are needed. This described multiplexer is built up with four 4 input and four 2 input multiplexers. The address for the multiplexer is the output of the block "5 counter".

The now following part of the explanation handles the blocks, which count the DTB trigger pulses and enable the DTB to trigger.
These trigger pulses are counted by the "high speed counter" block, which consists of 4 (or 5) 4 bit BCD counters.

At the begin of the MTB hold off period the block "load pulse logic" generates a load pulse which enables the "high speed counter" to load the number that is stored in the up/down counter. This loading takes place if the high speed counter receives a clock pulse from the block "count pulse logic".
This block lets pass in the first place the DTB trigger pulses.
Moreover it generates a clock pulse at the beginning og the hold-off period to assure that the high speed counter is also loaded if no trigger pulse occurs in this period.

During the sweep of the MTB the high speed counter counts the DTB trigger pulses from the presetted value to the terminal count value of 9998. The block "9998 detector" detects this value and enables the DTB to trigger on the next trigger pulse.

The high speed counter has been arranged in such a way that the 9998 detector only needs a two input rand gate to detect the 9998 value, thus the decoding logic is very simple. This is also achieved by using the nine's complement conversion principle.

The last part that has to be discussed is the "not triggered detector".
It uses a "150 msec. monostable multivibrator". The multivibrator stays triggered with input pulses with a repetion time of 150 ms or less.
If the multivibrator is triggered, the output of the detector stays high and the LED indicator on the output dims.

3.1.4. Switching unit and X amplifier

Apart from the blanking pulse selector and the X-deflection selector, the switching unit comprises an amplifier for external X-deflection signals and an intermediate amplifier. The X-deflection selector couples the external X deflection signal, the output signal of the main time-base generator or the combined output signals of the main and delayed time-base generators to the intermediate X amplifier and from there, via the final amplifier, to the horizontal-deflection plates. The intermediate amplifier comprises the horizontal trace positioning and 10x magnification controls.

The blanking pulse selector supplies blanking pulses to the Z amplifier. These pulses blank the trace at the end of the sweep of the main time-base and provide the extra bright-up pulse if the oscilloscope operates with a portion of the trace intensified. The blanking pulses during the switching of the traces in the chopped mode go direct from the channel selector logic to the Z-amplifier.

3.1.5. Z Amplifier and c.r.t. circuit

The Z amplifier receives two inputsignals. One originates in the time-base generator and is, via the switching circuit, applied to the Z amplifier to blank the trace during the flyback.
The other one is supplied by the channel selector logic to blank the trace during switching from channel to channel in the chopped mode. The INTENS potentiometer determines the amount of input current fed to the Z amplifier. At the output of the amplifier, the signal is split into two parts: an l.f. + d.c. part and an h.f. part. The h.f. part is fed direct to the Wehnelt cylinder of the c.r.t. The l.f. + d.c. part is modulated on to an oscillator signal and afterwards detected in a peak-detector. Both signal parts are combined again on the Wehnelt cylinder.

The focus voltage for the c.r.t. is generated in an oscillator. The output voltage of the oscillator is rectified, multiplied by a factor of 5 and applied to the focussing anode. The focussing voltage is controlled by the FOCUS potentiometer which is electronically coupled with the INTENS potentiometer. In this way, defocussing due to operation of the INTENS potentiometer is largely obviated.

The high voltage for the post-acceleration anode of the c.r.t. is supplied by a stabilized oscillator whose output voltage is rectified and multiplied by a factor of 9.

Furthermore, the c.r.t. circuitry comprises preset potentiometers for trace rotation, astigmatism, distortion and orthogonality.

3.1.6. Stabilized power supply

The mains voltage is full-wave rectified and fed to a voltage regulator.
The rectified mains voltage controls a blocking oscillator which generates a voltage at a frequency of approximately 20 kHz. This voltage is applied to the primary of a transformer.
The secondary voltages of this transformer are full-wave rectified, smoothed and applied to the various circuits.

The LINE triggering signal is taken direct from the mains and, via an opto-isolator, fed to the trigger circuitry on a safe level.
The calibration is a square-wave generator which supplies an accurate voltage and current for calibration purposes.

3.2. CIRCUIT DESCRIPTION OF THE DIGITAL DELAY PM3261 (Fig. 3.3.)

3.2.1. Discriminator enable counter + up/down counting

The detection of the position of count control R8 is achieved by two comparators: the first with TS2201, TS2202 and the second with TS2203, TS2204. In each comparator there is just one transistor conducting at the time. The collector load of TS2202 is formed by voltage divider R2212/R2219 that feeds base current to TS2206 if TS2202 conducts. In the same way TS2207 receives base current if TS2203 conducts. The bases of TS2201 and TS2204 are connected to the voltage divider R2224, R2222, R2226, R2223 and R2209.
The bases of TS2202 and TS2203 are connected to a voltage dividing network with count control R8. Other components in this network are:

- R2213, R2216 and trimming potmeter R2214, marked "symm".
  They allow elimination of base-emitter voltage differences in the comparator transistor, in order to obtain symmetrical behaviour of R8.
- R2204, R2207, R2201, R2202, R2206, R2211 enable the two comparators to detect if R8 is moved from its mid position.
  The diodes GR2201 and GR2202 start to conduct in the extreme positions of the slider of R8. This is important for a good regulation of the voltage controlled oscillator and will be discussed later on.

The circuit is arranged in such a way that R8 in its mid position causes TS2202 and TS 2203 and, thus, TS2206 and TS2207 to conduct.
The collectors of TS2207 and TS2206 now both give the logic information "low" to the succeeding logic.
For the used TTL logic "low" means a voltage level between 0 and 0,8 V, "high" means a voltage level between 2 and 5 Volt.
Moving R8 to the left on the circuit diagram (clockwise on text plate of oscilloscope) only changes the state of comparator TS2203, TS2204. Then TS2204 becomes conducting.
TS2206 and TS2207 give respectively a "low" and a "high" to the logic.
Moving R8 from its mid position to right (anti-clockwise on text plate) changes the state of comparator TS2201, TS2202: TS2201 starts to conduct. TS2206 and TS2207 now give respectively a "high" and a "low" to the logic.
Trimming potentiometer R2224, marked "gap", enables adjusting of the angle over which R8 can be turned out of its mid position without changing the state of one of the comparators.
Decreasing R2224 narrows the gap because the voltage on the bases of the non-conducting transistors comes closer to that of the conducting ones.
The collectors of TS2206 and TS2207 are connected with logic circuits that derive the logic information "enable counter", the inverse of "enable counter" and "up/down counting".
These logic circuits are the inverters IC2301/A,1,2, IC2301B,3,4, IC2301C,13,12 and the nand gates IC2302A,9,10,8, IC2303A,4,5,6, IC2302/B12,13,11, IC2303/B1,2,3, IC2303/C9,10,8.
How the important in- and outputs of this logic depend on each other as functions of R8 is explained in the following table.

Position	Inputs logic		Outputs logic		
R8	IC2301/A pin 1	IC2301/B pin 3	IC2301/D pin 6 up/down	IC2301/C pin 12 counter enable	IC2303/C pin 8 inv. counter enable
middle	low	low	x	high	low
left (diagram)	high	low	low	low	high
right (diagram)	low	high	high	low	high

x = state is not defined and not important.

Feedback resistor R2227 connects the base circuit of the comparators to the counter enable output of the logic. The resistor gives a hysterisis to the comparators and assures stable operation.

3.2.2. Voltage controlled oscillator

The voltage on the slider of R8 controls the oscillator frequency.
This voltage is at its lowest (about 600 mV) in the mid position of R8.
Moving the slider clockwise or anti-clockwise out of the middle increases the voltage.

Moving the slider towards its end-positions makes either GR2201 or GR2202 conductive and gives a voltage of about 4300 mV on the slider.
The slider voltage is able to charge C2203 via a combination of 2 resistors and a diode. In the normal counting range C2204 is switched parallel to C2203 via SK5. The capacitor is charged, via R2230 only, if the slider voltage is below 1200 mV.
Above 1200 mV GR2204 connects R2228 in parallel to R2230.
Trimming potmeter R221 allows frequency adjustment.
IC2201 is an operational amplifier with an inverting input (—) and a non-inverting input (+). This operational amplifier forms the heart of the voltage controlled oscillator. The inverting input is kept at about 500 mV by means of R2231 and R2234. The use of the other components at this input is discussed later on. The non-inverting input stays at the same voltage as C2203 (and C2204).
TS2209 inverts the output of the operational amplifier TS2208 discharges C2203 (and C2204) periodically.
TS2208 and TS2209 will conduct if the output of the operational amplifier is high (+6 V).
The explanation how oscillation takes place starts with the situation that C2203 charges: thus the voltage on the non-inverting input rises.
In this state the voltage on the inverting input is still higher.
So the output of the operational amplifier is low (—6 V), and TS2208 and TS2209 do not conduct.
At the moment that the voltage at the non inverting input exceeds the other input, the output of the operational amplifier becomes high.
At the moment TS2209 starts to conduct and by means of C2202 the inverting input is pulled down by about 5500 mV. After C2202 is charged, R2232 keeps this voltage at 460 mV. C2202 is added to assure fast switching and R2232 to make a hysteresis of 40 mV. So the inverting input is 40 mV beyond the non-inverting input. At the moment the output of the operational amplifier becomes high, TS2208 starts to conduct and discharges C2203.
At the moment the voltage on C2203 has dropped by 40 mV, the non-inverting input comes just beyond the inverting input and the output of the operational amplifier becomes low (—6 V), thus TS2208 and TS2209 stop conducting and C2203 charges again.
Fast switching is also now assured by C2202.
The generated pulses on the collector of TS2209 are inverted twice by means of IC2301/D5,6 and IC2301/E11,10 to make the risetime short enough for good operation of the up down counter.

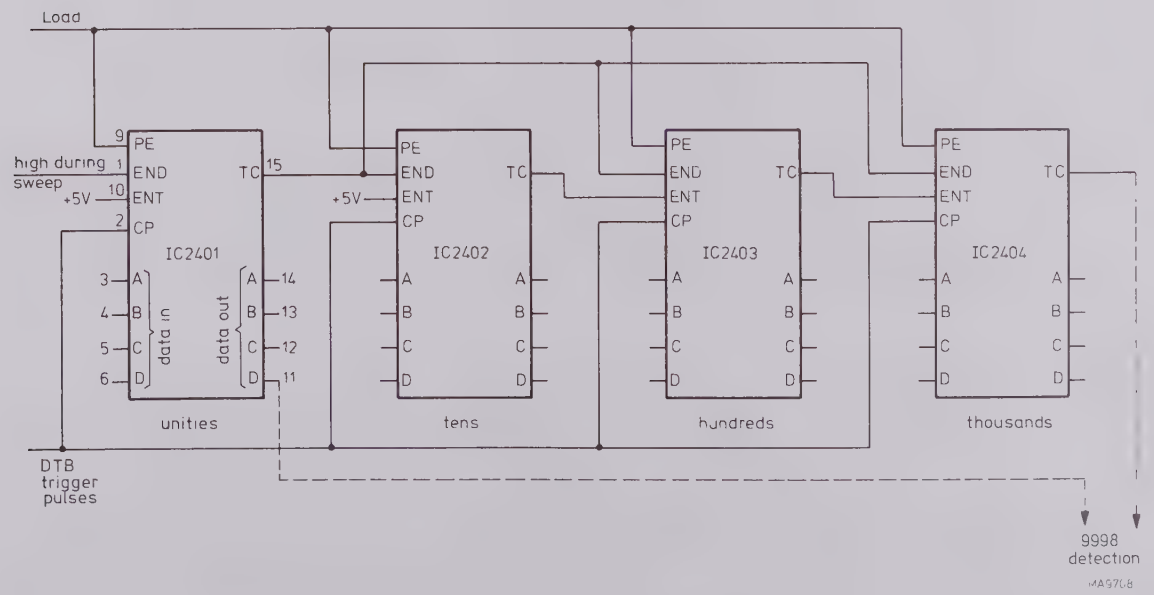
The oscillator can be triggered by a negative going pulse which reaches the inverting input of the operational amplifier via GR2203 and C2201.
C2201 is connected with the "enable counter output" of the discriminator circuit (IC2301/C12). Triggering takes place if R8 leaves its mid position. The oscillator then generates a clockpulse a certain delay time after the enable counter output becomes low. This delay is caused by the inverters in the oscillator.
R2229, connected in parallel to GR2203 charges C2201 if the enable counter output becomes high again. This triggering prevents the clock input of the up down counter from changing together with the enable counter input.

3.2.3. Up down counter

The counter is built up with 4 (or 5) presettable BCD up down decade counters. They are marked IC2306 to IC2309 (or to IC2310) and count respectively the unities, the tens, the hundreds, the thousands and in case of a fifth digit the ten thousands.
Counting occurs on the low to high level transistion of the clock input (pin 14) with a low enable count input (pin 4). The enable count inputs of the decade counters are all connected to the corresponding outputs of the discriminator block. The decade counters count from 0 to 9 in BCD. The BCD number consists of 4 bits, so every decade counter has 4 outputs. The pin numbers of these outputs from the least to the most significant bits are 3, 2, 6 and 7.
In case of an overflow when counting up or an underflow when counting down the ripple clock output (pin 13) produces a low level pulse equal to the low level portion of the input clock.
The up or down count depends on the level on pin 5: when low the counter counts up, when high it counts down.
The up down inputs of the decade counters are all connected to the corresponding output of the discriminator block.
The BCD decade counters are connected in cascade: the clock input of the first counter receives its clock pulses from the voltage controlled oscillator, the other counters receive their clock pulses from the ripple clock output of the preceding counter.
The counter is able to count up or down from (0)0000 to (9)9999.
A low level on pin 11 enables the counter to load a preset number.
This load command overrules all other commands. The preset number is put on the pins 15 (least significant bit), 1, 10 and 9 (most significant bit). A floating input results in a high input and an input connected to earth results in a low input.
If the digital delay unit is switched on, a one second load pulse from a one shot multivibrator is put on all counter load inputs and the counters are loaded with the BCD number (9) 9998.

3.2.4. High speed counter

The counter is built up with 4 (or 5) presettable high speed BCD decade counters. They are marked IC2401 to IC2404 (or to IC2405) and count respectively the unities, the tens, the hundreds, the thousands and in case of the fifth digit the ten-thousands.



To get a good view of the interconnections between the decade counters, the counter for 4 decades is showed in the above diagram.
For 5 decades it is necessary to connect a fifth decade counter to IC2404 in the same way as IC2404 is connected to IC2403.
Counting occurs on the low to high clock transistion with enable P (pin 7) high, with enable T (pin 10) high

and with parallel enable (pin 9) high. The clock pulse inputs (pin 2) of the decade counters all receive the DTB clockpulses.
The terminal count of a decade counter (pin 15) generates a high level in the terminal count state if enable T is high. Every decade counter has 4 data inputs for parallel loading of a BCD coded number.
The pin numbers of these inputs are 3 (least significant bit), 4, 5 and 6 (most significant bit). Loading occurs at the positive clock transition with the parallel enable input (pin 9) low.
As the data inputs are connected to the corresponding outputs of the up down counter, the high speed counter is then loaded with the number in the up down counter. The decade counter has 4 outputs with pin numbers 14 (least significant bit), 13, 12 and 11 (most significant bit).
The enable P, enable T and terminal count of the decade counters are interconnected in such a way, that the terminal count outputs of the decade counters become high at certain counter conditions.
These conditions are explained below for every decade counter as a function of the number in the counter.
X indicates a do not care situation for the decade counter concerned.

- IC2401: terminal count is high if the number is XXX9
- IC2402: terminal count is high if the number lies between XX90 and XX99.
- IC2403: terminal count is high if the number lies between X990 and X999.
- IC2404: termina count is high if the number lies between 9990 and 9999.

The counter described below facilitates detecting the end of count condition. This condition is the number 9998 and can be detected with a two input nand gate as discussed in the following section.

3.2.5. The 9998 detector

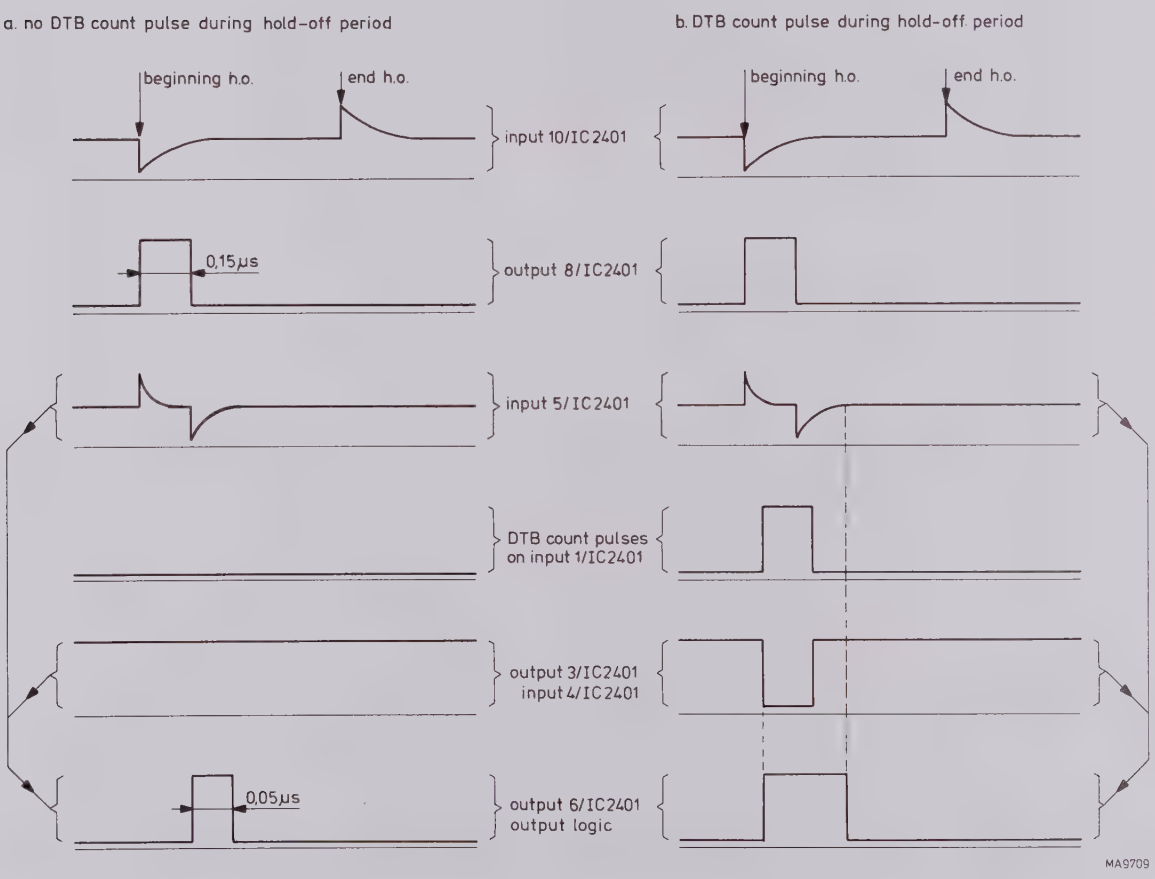
This block sets the DTB ready to trigger on the next pulse after having detected the end of count condition of the high speed counter.
This condition is the number 9998 and is reached if the terminal count of IC2404 (pin 15) is high and if the most significant bit of IC2401 (pin 11) becomes high.
This condition is detected with the two input nand gate IC2407/12,13,11.
In case of 4 counting digits input 12 of IC2407 is connected to terminal count output 15 of IC2404 via the soldering bridge marked f.d. (fifth digit). This bridge is disconnected if the fifth decade counter IC2405 is placed in case of 5 digits. Now input 12 of IC2407 is connected to terminal count output 15 of IC2405.
This terminal count becomes high if the number in the counter lies between 99990 and 99999.
The nand gates IC2408/1,2,3 and IC2408/4,5,6 form a set-reset flip-flop, that is triggered by a high to low transition of one of the inputs. If the flip-flop is set, the output (pin 6 of IC2408) becomes high. This occurs at the negative transistion of input 5 of IC2408 at the moment that the 9998 value of the high speed counter is detected by the preceding nand gate.
The flip-flop is reset (low output) at the negative pulse on input 1 of IC2408. This takes place at the begin of the hold-off period.
The output of this block is the collector of TS2402.
The base of TS2402 receives signal from a discrete and gate built up with GR2404, GR2406 and R2411.
If the delay is switched off, GR2406 conducts and TS2402 is not able to get base current. With switched on delay TS2402 gets base current if the output of the flip-flop is high. So TS2402 conducts from the 9998 detection point till the beginning of the hold-off period.
If TS2402 conducts its collector send current to the delay time base and enable it to trigger on the next incoming pulse.

3.2.6. Load pulse logic

This block contains the nand gates IC2408/12,13,11 and IC2408/9,10,8.
IC2408/9,10,8 works as an inverter. They are connected in such a way that they function as an and-gate.
The input of this block which is input 12 of IC2408 is high during the MTB sweep. Input 13 of IC2408 is connected to a low voltage level (via GR2403) if the delay is switched off. The output of this block which is output 8 of IC2408 is only high during the MTB sweep and if the digital delay is switched on.
During the MTB hold-off period this output gives a load command to the high speed presettable counter. Moreover it resets the flip-flop in the 9998 comparator gate at the begin of the hold-off period.

3.2.7. Count pulse logic

Input transistor TS2401 receives the DTB count pulses on its emitter. In case of a count pulse the collector current of TS2401 is about 20 mA. With no pulse the collector current is about 3 mA. Collector load resistor R2403 has such a value that in case of a count pulse the input 1 of IC2407 detects a high voltage level. With no count pulse the detected level is low.
The other active elements in this block are 3 nand gates IC2407/1,2,3, IC2407/4,5,6 and IC2407/9,10,8 that works as an inverter. These gates work together with 2 RC circuits in such a way that the output 6 of IC2407 always generates a pulse during the hold off period. This is necessary to load the high speed presettable counter.
How the voltage levels on inputs and outputs of the concerned nand gates behave at the beginning and the end of the hold-off period, with or without DTB count pulses, is showed in the figure:



This figure shows the situation in which the digital delay is switched on. If it is switched off, input 2 of IC2407 and input 10 of IC2407 are kept at a low level via GR2402.
In this case output 6 of IC2407 produces a low level.

3.2.8. The 5 to 1 line multiplexer

In case of a display of 5 counting digits the five decade counters of the up down counter are scanned one by one by a 5 to 1 line multiplexer.
This 5 to 1 line multiplexer function is achieved by a 4 to 1 line multiplexter that scans the unities, tens, hundreds and thousands and a 2 to 1 line multiplexer that scans the output of the 4 to 1 line multiplexter and the ten-thousands. Which decade counter is scanned depends on the 3 bit address generated by the block ."5 counter".
The most significant bit of this address determines the position of the 2 to 1 line multiplexer. A "0" switches the output of the 4 to 1 line multiplexer on .A "1" switches the ten-thousands on.

The other two bits of the address determine the position of the 4 to 1 line multiplexer: "00" switches the units on, "01" switches the decades on, "10" switches the hundreds on and "11" switches the thousands on.
It is easy to understand that the generated addresses make the multiplexers scan the following decade counters: address "000" switches the units through, "001" the decades, "010" the hundreds, "011" the thousands and "100" the ten-thousands.
As every decade counter has four outputs that must be scanned at the same time, four 4 to 1 line and four 2 to 1 line multiplexers are needed. For this two dual 4 to 1 line multiplexer IC's of the type N 74LS153B are used and one quad 2 to 1 line multiplexer IC of the type N74LS157B.
As the preceding explanation was based on a five digit counting display, some attention is paid to the four digit situation.
In this situation the fifth digit shows the counting sign if the display changes and is blanked if the display is stable. To make this indication possible the multiplexer receives in the position of address "100" a certain 4 bit BCD code. This code is 1010 for a blanked fifth digit and 1111 for the counting sign. Two bits in these codes do not change and stay high with both stable and changing display.
These inputs are connected to the corresponding pins of the counters for the ten-thousands that are not placed. So these inputs are floating which is detected as a high level.
If the fifth digit of the display is blanked the other two bits of the BCD are low.
If the fifth digit shows the counting sign, these two bits are high. To achieve this, these bits are connected via the soldering bridges marked c.s. (count sign) to the output "inverted enable counter" of the "discriminator" block.

3.2.9. The 1 kHz clock generator

The oscillator consists of two nand gates IC2302/4,5,6 and IC2302/1,2,3 with their associated components. Both nand gates function as an inverter and due to the RC feedback networks between pin 6 and 2 and between 3 and 4 oscillation takes place.
The output of the oscillator which is output 3 of IC2302 gives a 1 kHz square wave.

3.2.10. The 5 counter

This 5 counter uses IC2312 of the type SN74L90N. This IC contains a flip-flop with a devide by two function and a three flip-flop devide by five function. Only the devide by five function is used and the IC receives on pin 1 pulses from the 1 kHz clock generator. The three outputs now generate in succession the codes: 000, 001, 010, 011, 100, 000 and so on.
The pin numbers of these outputs are from the most to the least significant bit 9, 8 and 11.
The IC also has some reset possibilities that are not in use: the zero reset is made inactive by connecting pin 3 to earth and the set to nine is made inactive by connecting pin 6 and 7 to earth.

3.2.11. The BCD to decimal converter

This converter uses the IC2101 of the type SN744SN which contains the BCD to decimal converter.
The converter has four inputs of which the most significant bit (pin 12) is not in use and connected to earth.
The three other inputs are connected to the corresponding outputs of the five counter. These inputs have the pin numbers 13 (most significant bit), 14 and 15 (least significant bit).
The converter has 10 outputs of which the selected one becomes low, the others stay high. Because of the applied input code only the first 5 outputs are selected to become low. They are the outputs 0,1,2,3 and 4 with the pin numbers 1,2,3,4,5. The other outputs are not in use.

3.2.12. The four bit adder

This block uses IC2104 of the type 74LS83B, which contains the four bit adder. This adder adds 6 in BCD to the decade of the up down counter that is selected by the multiplexer. The inputs 1 (most significant bit), 3, 8 and 10 (least significant bit) are connected to the corresponding outputs of the multiplexer.
The other four inputs receive the preset number 6, which is 0110 in BCD. A low input level is achieved by connecting the relevant input to earth and a high input level by connecting it to +5 volt. As the most (pin 16) and the least significant bit (pin 11) must be low, they are connected to earth and the other two inputs (pin 4 and 7) are connected to +5 volt. The carry input (pin 13) is connected to earth as there is not any input carry. The 4 outputs of the adder are connected to pins 15 (most significant bit), 2,6 and 9 (least significant bit). The carry output (pin 14) is not in use.

3.2.13. The inverter

This block is formed by IC2106. This IC is a hex inverter of the type N74LS04A. Four inverters are used to invert the outputs of the preceding four bit adder. This inversion in co-operation with the addition produces the nine's complement of the decade of the up down counter that is selected by the multiplexer.

The fifth inverter is used to drive the decimal points in the display. These points indicate counting if the fifth digit is in operation. In this case the input of this inverter (pin 13) is connected via a soldering bridge marked d.p. (= decimal point) to output 12 of IC2301. This output is the "enable counter output" of the block "discriminator enable counter and up/down counting".
The output of this inverter becomes high if the up down counter counts.

3.2.14. The BCD to 7 segment decoder

The decoder is housed in IC2107. This IC of the type SN74249N has 4 inputs with pin numbers 6 (most significant bit), 2,1 and 7 (least significant bit). These inputs are connected to the corresponding outputs of the inverters. Each of the 7 outputs is connected with one of the 7 segments in the display. Depending on the BCD input code the desired segments are activated by giving them a high level.
If the digital delay is switched off input 4 and 5 of the decoder become low and the display is blanked.

3.2.15. The display

This five digit LED display is built up in two packages: GR3 and GR4.
GR3 has 2 digits and has part number 5082-7432. GR4 has 3 digits and has part number 5082-7433. If replacement of GR3 is necessary it is possible to replace GR3 by a 3 digit display of which one digit is not used.
Every digit has one common cathode, which is activated by one of the 5 outputs of the BCD to decimal converter (IC2101). The five outputs of this converter become low one by one and thus are the cathodes of the 5 digits activated one by one.

The anodes are the 7 segments in every digit. These anodes are connected via resistors of 562 ohm with +5 volt. Moreover they are connected with the corresponding outputs of the BCD to 7 segment decoder. The segments that are connected to low outputs are blanked and the segments connected to high outputs light up. Besides the 7 segment anodes every digit also has a decimal point anode. This anode is connected to +5 volt via R2111. A low output 12 of the inverter IC2106 results via diode GR2102 in a low level of the decimal point anode and the point is blanked.
If output 12 is high GR2102 does not conduct and the decimal point lights up. GR2102 prevents, in this situation that the totem pole output of the inverter gives undefined current to the decimal point LED. As the BCD to 7 segment decoder has open collector outputs there are no diodes required to control the 7 segments in the digits.

3.2.16. The 1 second monostable multivibrator

This block uses one half of the IC2304 of the type SN74L123N.
The block generates a 1 second low level output pulse on pin 12 if the input (pin 9) becomes low and in case the supply voltage is switched on. The input becomes low if the delay is switched off. The pulse duration time is determined by C2302 between pin 6 and 7 and by R2301 between pin 15 and +5 volt. The 1 second output pulse is used as a load pulse for the up down counter.

3.2.17. The DTB not triggered indicator

This block uses the other half of IC2304, the nand gate IC2303/12,13,11 and the not triggered LED indicator GR2. The monostable multivibrator is arranged in such a way that it remains triggered on input pulses with a duration time of 150 msec. or less.
The time is determined by C2303 between pins 14 and 15 and R2302 between pin 15 and +5 volt.
The trigger pulses are derived from the DTB and the input level on pin 1 is low during the DTB sweep. If the multivibrator is triggered its output is low and so the output 11 of the nand gate is high and the LED indicator is blanked. With no trigger pulses the input and output of the multivibrator are both high, so the two inputs of the nand gate are high. The output 11 of the nand gate is low and the LED lights up.

Remark: All digital IC's are connected to the +6 volt supply via diode GR2401. This lowers the voltage on these IC's to about 5 volt in order to limit the power dissipation.

3.2.18. How inputs and output of the digital delay co-operate with the time basis circuits

- "DTB count pulses" input. The DTB count pulses are derived from pin 21 of IC1001 in the delayed trigger circuit by means of TS1045. Pin 21 is inside IC1001 connected with the collector of one of the two transistors of the trigger multivibrator and outside the IC with the emitter of TS1045 and R1130. Pin 21 draws current in absence of a triggering signal and TS1045 does not receive emitter current.
  The multivibrator is switched over by a triggering signal (the IC generates a trigger pulse) and pin 21 does not draw current till the multivibrator switches back again. If pin 21 does not draw current TS1045 receives emitter current and sends collector current to R2401 on the digital delay during the time the pulse appears.
- "MTB gate" input. The MTB gate input signal is derived from the MTB sweep gate multivibrator TS801/TS802 by means of TS800. TS800 is incorporated in the collector-circuit of TS801 in such a way that both transistors conduct at the same time. So TS800 sends collector current to the digital delay during the hold off period and input 12 of IC2408 on this unit is kept at a low level.
  This input is high during the MTB sweep.
- The input of the not triggered indicator. This input is connected via R1210 with the collector of TS1203 in the DTB sweep circuit. The collector of TS1203 is low during the DTB sweep.
- The output "DTB hold-off multivibrator". This output is the collector of TS2402 and this transistor substitutes the comparator TS1226. If the digital delay comes into operation the current source TS1227 is switched off by connecting its emitter via R1292, SK2 and SK20 to earth. Now the comparator is also switched off and the voltage drop on the left hand collector of TS1226 is achieved by the collector current of TS2492 in R1288 and R1289.

3.2.19. PM 3261 TTL trigger facility

The PM3261 MTB trigger circuit diagram is now explained as far as it differs from the PM3260 diagram.

The wiring of SK19 and SK21 has been changed. The 3 pushbuttons of SK19 are used for TTL trigger mode and AC or DC trigger coupling.
The pushbutton marked "AC" controls the function of HF trigger coupling and the pushbutton marked DC the function of DC trigger coupling as described for the PM3260. As there is not any possibility for LF trigger coupling the current source TS628 is not necessary in the PM3261.

A signal on the external trigger socket BU8 is applied to the base of TS2501 via voltage devider R2501, C2501 R2504, C2503.
C2502 permits AC coupling of the input signal if AC trigger coupling is choosen. In the other cases is C2502 short-circuited via R2502, SK19C and R2503.
Emitterfollower TS2501 is so biased that a high input impedance is obtained but a poor HF response. For high frequencies an additional HF path with emitterfollower TS2502 is necessary. The output signals of TS2501 and TS2502 are applied to emitterfollower TS2503. The output of this transistor feeds the input of TS608 in the MTB trigger circuit.

The amplification of TS603 and TS618 is decreased in the TTL mode in order to adapt the trigger gap of the main trigger to the TTL gap of 1,2 volt. This is achieved by connecting R9037 and R9038 parallel to respectively R614 and R657 in the TTL mode by applying the cathodes of GR9031 and GR9032 to earth via SK19A and SK21A.

The trigger level is fixed in the TTL mode and the level control switched off. This is achieved by applying R708 to earth via SK19C, SK19B and SK21A. R708 prevents in this situation excessive current drain from the power supply in the utmost positions of level control R8.
Because of the fixed trigger level the drift of the amplifier stage TS643/TS646 has been decreased.
This is done by changing the collector load resistors in such a way that the power dissipation of TS643 and TS646 becomes less dependent on their collector current.
Moreover the diodes GR608 and GR609 are added in the base circuit.
They prevent in case the level control stays in one of its utmost positions that the base-emitter voltage of TS643 or TS646 becomes too negative, because this may cause after some time a decrease of the current gain of the involved transistor.

Current source TS2 on IC601 is biased by a resistor network with NTC resistor R9051 to eliminate temperature drift.

4. Dismantling display unit

This unit, on which the 7-segment display and the corresponding driver circuits are located, becomes accessible as follows:

– Loosen the horizontal display mode and digital delay switch assembly.
  Bend this switch over the main time base unit.

– Loosen the potentiometer unit (level/slope, count and horizontal position) by removing the two hollow nuts under the level/slope knobs.
  Take care not to lose the washers underneath the spacers.

For remaining units refer to basic PM 3260 manual.

5. Adjusting the digital delay section

Adjustment controls R2224 - Gap
R2214 - Sym.
R2211 - Freq.

/‾ indication.

1. No inputsignals
2. MAIN TB and DIGITAL DELAY of horizontal display switch depressed.
3. MAIN TB of delayed time-base trigger source switch **not** depressed.
4. Knob COUNT in centre-lock position.
5. The /‾ indication must be suppressed also if the COUNT knob is pulled out.
   If not, adjust GAP pot. meter R2224.
6. As soon as the COUNT knob is turned out-off the lock position the /‾ indication must be visible, also if the COUNT knob is pulled-out.
   If not, adjust SYM pot. meter R2214.

– Display setting frequency

7. As soon as the COUNT knob (in depressed position) is turned out-off the lock position the display contents must change a number of 10 during 12 up to 18 sec.
   If necessary, adjust FREQ. pot. meter R2211.

6. Parts list

For standard mechanical parts refer to the basic PM3260 manual, except for the following:

Text plate (front)	5322 455 84066

Switches

Dig. horizontal mode switch SK2	5322 276 44081
Time base mode switch SK9	5322 276 34059
Trig. source switch unit SK18-SK21	5322 705 32681

Units

Attenuator complete	5322 216 54232
Intermediate amplifier	5322 216 54228
Digital delay unit	5322 216 54234
Digital delay display unit	5322 216 54227
M.T.B. External trigger unit	5322 216 54173
Correction unit	5322 216 54229
Adjusting unit	5322 216 54231

Note: The M.T.B. and D.T.B. unit codenumbers can be taken from the PM3260 manual, though these units must be modified according figures 3.11 and 3.14.

Complete electrical parts list PM3261

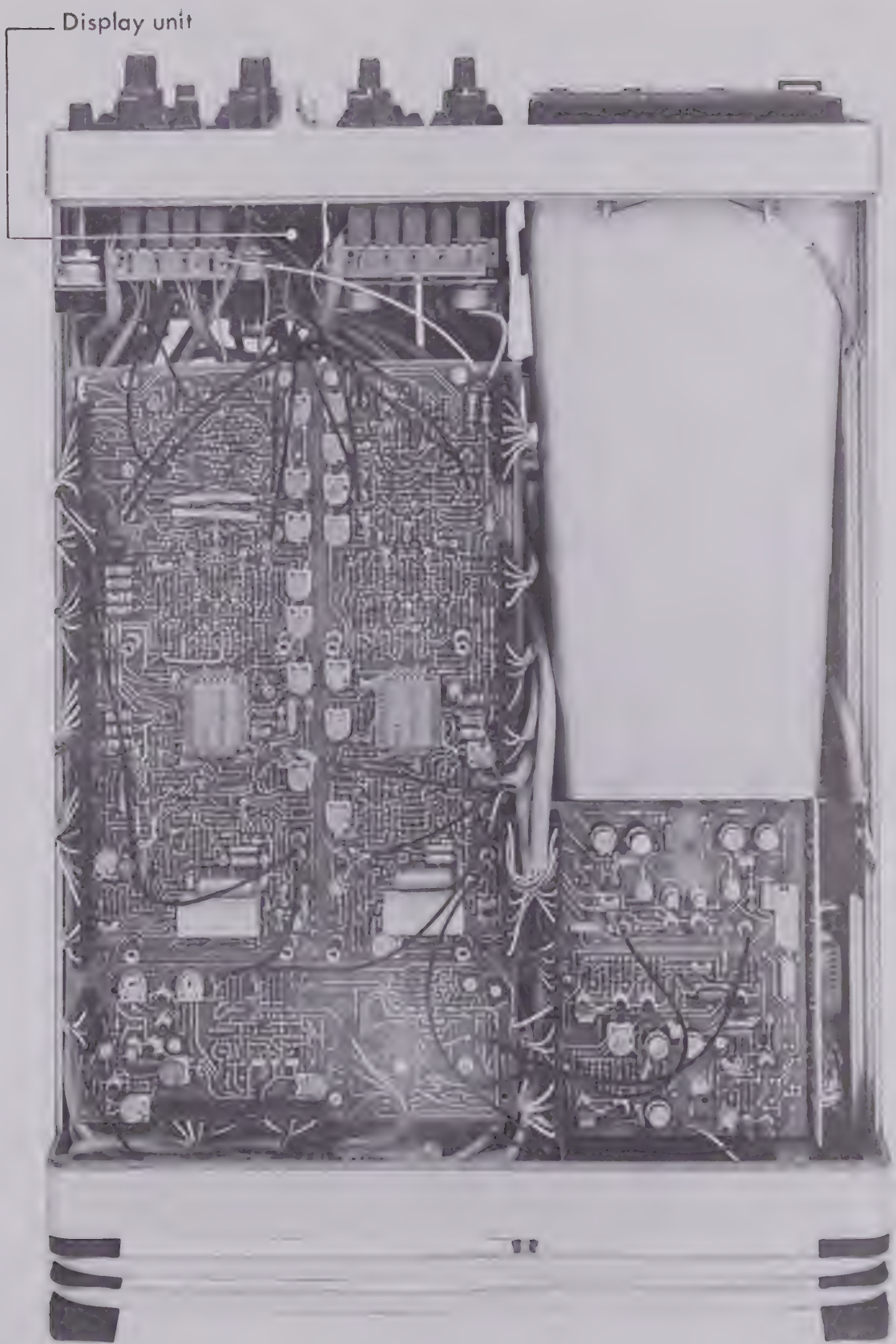


Fig. 3.3. Unit location PM3261, top view

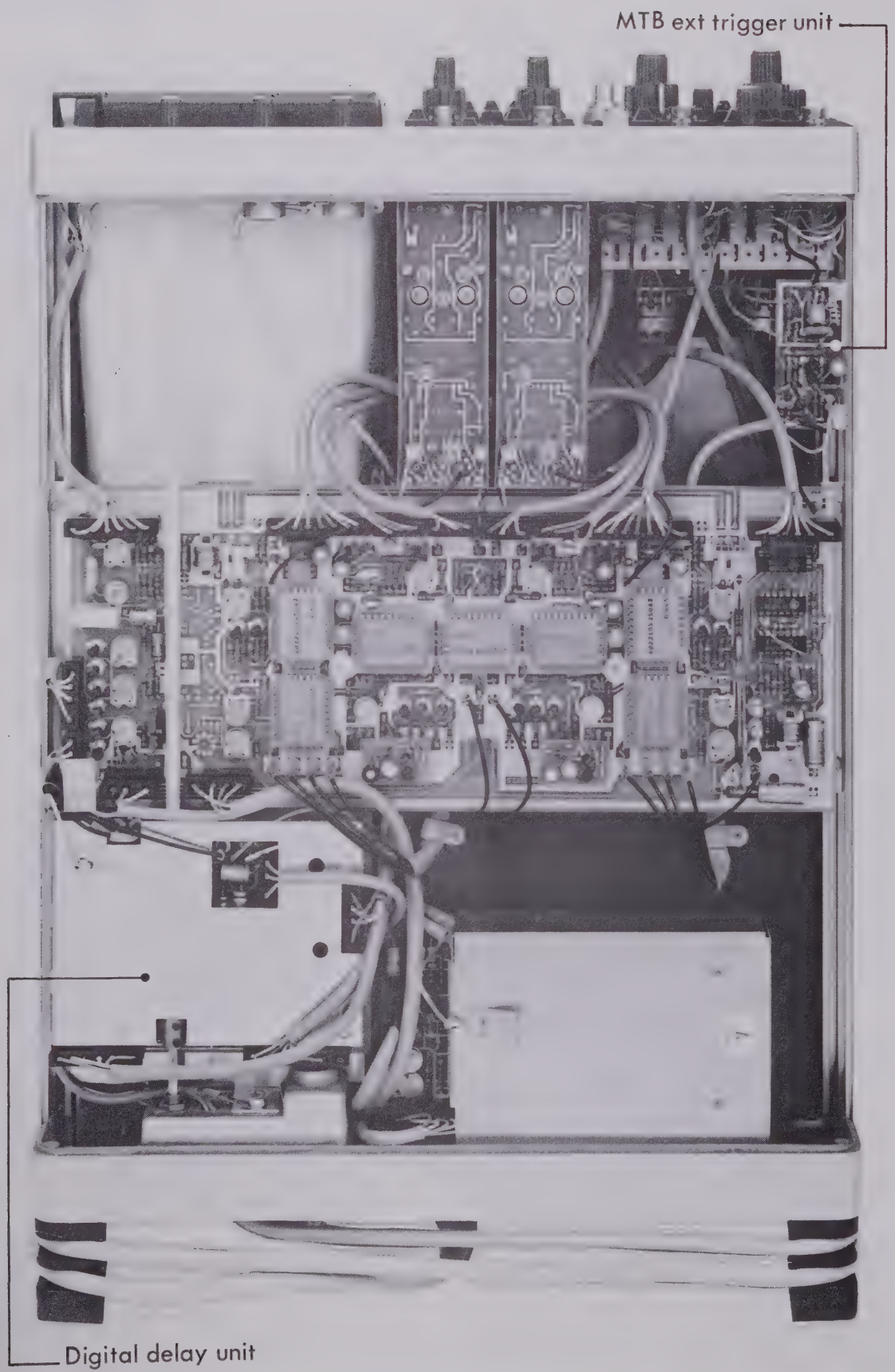


Fig. 3.4. Unit location PM3261, bottom view

Electrical parts list

CAPACITORS

SERV. CODE	VALUE	TOL. (%)	V	POS
5322 122 14018				C1
5322 125 54003				C2
5322 125 54051				C3
5322 125 50051				C4
5322 125 64009	3PF		500	C101
5322 125 64015	4,5PF		500	C102
5322 123 34001	30PF	10	300	C103
4822 121 40278	22NF	10	400	C104
4822 122 31047	5,6PF	0,25PF	100	C105
4822 122 31072	47PF	2	500	C106
5322 125 64012	1,5PF		500	C107
5322 125 64014	3PF		500	C108
5322 125 64009	3PF		500	C109
5322 125 64015	4,5PF		500	C111
5322 123 10168	300PF	10	300	C112
4822 122 30043	10NF	-20+80	40	C113
4822 122 30043	10NF	-20+80	40	C114
4822 122 31173	220PF	2	500	C116
4822 122 31047	5,6PF	0,25PF	100	C117
4822 122 30043	10NF	-20+80	40	C118
4822 122 30043	10NF	-20+80	40	C119
5322 125 50049	10PF		300	C120
4822 122 31125	4,7NF	-20+80	40	C121
4822 124 20452	33UF	-10+50	6,3	C122
4822 122 30027	1NF	-20+80	40	C123
5322 125 50048	3,5PF		300	C124
4822 122 30043	10NF	-20+80	40	C128
4822 122 30043	10NF	-20+80	40	C129
4822 122 30043	10NF	-20+80	40	C130
4822 122 30043	10NF	-20+80	40	C301
4822 122 30043	10NF	-20+80	40	C302
4822 122 30043	10NF	-20+80	40	C303
4822 122 30043	10NF	-20+80	40	C304
4822 121 40407	22NF	10	250	C307
4822 122 30043	10NF	-20+80	40	C309
4822 122 30043	10NF	-20+80	40	C311
4822 122 30043	10NF	-20+80	40	C312
4822 122 30043	10NF	-20+80	40	C313
4822 122 30043	10NF	-20+80	40	C314
4822 122 30043	10NF	-20+80	40	C316
4822 122 30043	10NF	-20+80	40	C317
4822 122 30043	10NF	-20+80	40	C318
4822 122 30043	10NF	-20+80	40	C323
4822 122 30043	10NF	-20+80	40	C324
4822 122 30128	4,7NF	10	100	C325
4822 122 30043	10NF	-20+80	40	C326
4822 122 30043	10NF	-20+80	40	C328
4822 122 30043	10NF	-20+80	40	C329
4822 122 30043	10NF	-20+80	40	C330
4822 122 30043	10NF	-20+80	40	C331
4822 124 20469	68UF	-10+50	16	C332
4822 122 30043	10NF	-20+80	40	C335
4822 122 30043	10NF	-20+80	40	C336
4822 122 30043	10NF	-20+80	40	C337
4822 122 30043	10NF	-20+80	40	C338
4822 122 30043	10NF	-20+80	40	C339
4822 122 30043	10NF	-20+80	40	C341
4822 122 30043	10NF	-20+80	40	C351
4822 122 30043	10NF	-20+80	40	C352
4822 122 30043	10NF	-20+80	40	C353
4822 122 30043	10NF	-20+80	40	C354
4822 121 40407	22NF	10	250	C357
4822 122 30043	10NF	-20+80	40	C361
4822 122 30043	10NF	-20+80	40	C362
4822 122 30043	10NF	-20+80	40	C363
4822 122 30043	10NF	-20+80	40	C364
4822 122 30043	10NF	-20+80	40	C366
4822 122 30043	10NF	-20+80	40	C367
4822 122 30043	10NF	-20+80	40	C368
4822 122 30193	22NF	-20+80	40	C371
4822 122 30043	10NF	-20+80	40	C373
4822 122 30043	10NF	-20+80	40	C374
4822 122 30128	4,7NF	10	100	C375
4822 122 30043	10NF	-20+80	40	C376
4822 122 30103	22NF	-20+80	40	C377
4822 122 30043	10NF	-20+80	40	C378
4822 122 30043	10NF	-20+80	40	C379
4822 122 30043	10NF	-20+80	40	C380
4822 122 30043	10NF	-20+80	40	C381
4822 124 20469	68UF	-10+50	16	C382
4822 124 20452	33UF	-10+50	6,3	C384
4822 122 30043	10NF	-20+80	40	C385
4822 122 30043	10NF	-20+80	40	C386
4822 122 30043	10NF	-20+80	40	C387
4822 122 30043	10NF	-20+80	40	C388
4822 122 30043	10NF	-20+80	40	C389
4822 122 30128	4,7NF	10	100	C400
4822 122 30128	4,7NF	10	100	C401
4822 122 30057	2,7NF	10	100	C402
4822 122 31169	1,5NF	10	100	C403
4822 122 31054	10PF	2	100	C405
5322 121 44025	33NF	10	250	C406
5322 125 50051	18PF		300	C407
4822 122 30128	4,7NF	10	100	C408
4822 122 31085	150PF	2	100	C409
4822 122 31038	2,7PF	0,25PF	100	C410
4822 122 30128	4,7NF	10	100	C411
4822 122 31085	150PF	2	100	C412
5322 121 44138	47NF	10	250	C413
5322 121 44138	47NF	10	250	C414
4822 122 30128	4,7NF	10	100	C416
4822 122 31085	150PF	2	100	C417
4822 122 30104	1PF	0,25PF	100	C418
4822 122 30128	4,7NF	10	100	C419
4822 122 30128	4,7NF	10	100	C421
4822 122 30043	10NF	-20+80	40	C422
4822 122 30104	1PF	0,25PF	100	C423
4822 122 30043	10NF	-20+80	40	C500
4822 122 30103	22NF	-20+80	40	C501
4822 122 30128	4,7NF	10	100	C502
4822 122 31116	2,2NF	10	500	C503
4822 121 41161	100NF	10	250	C504
4822 121 41161	100NF	10	250	C505
4822 122 30043	10NF	-20+80	40	C506
4822 122 30034	470PF	2	100	C507
4822 121 41161	100NF	10	250	C508
5322 125 50048	3,5PF		300	C509
4822 122 31197	15PF	2	500	C510
4822 122 30128	4,7NF	10	100	C511
4822 122 30043	10NF	-20+80	40	C513
4822 122 30098	3,9NF	10	100	C514
4822 122 30043	10NF	-20+80	40	C515
4822 122 30043	10NF	-20+80	40	C516
4822 122 30098	3,9NF	10	100	C517
4822 122 30043	10NF	-20+80	40	C518
4822 122 30043	10NF	-20+80	40	C519
4822 122 31197	15PF	2	500	C520
5322 122 50044	1NF	-20+50	3K	C521
5322 122 50001	4,7NF	-20+50	3K	C522
4822 121 40411	33NF	10	250	C523
4822 122 31211	100PF	10	500	C524
5322 125 50048	3,5PF		300	C525
4822 121 41161	100NF	10	250	C526
4822 121 41161	100NF	10	250	C527
4822 121 40366	15NF	10	1000	C528
4822 121 40195	33NF	10	1600	C529
5322 122 50001	4,7NF	-20+50	3K	C530
4822 121 40429	220NF	10	630	C531
4822 122 31174	2,7NF	10	500	C532
4822 122 31174	2,7NF	10	500	C533
5322 122 50044	1NF	-20+50	3K	C534
4822 122 31174	2,7NF	10	500	C536

SERV. CODE	VALUE	TOL. (%)	V	POS
4822 121 40411	33NF	10	250	C537
4822 121 40411	33NF	10	250	C538
4822 122 30103	22NF	−20+80	40	C539
4822 122 30043	10NF	−20+80	40	C541
4822 122 30043	10NF	−20+80	40	C542
4822 122 30043	10NF	−20+80	40	C543
4822 124 20475	10UF	−10+50	25	C547
4822 122 31192	6,8PF	0,5PF	500	C601
4822 122 31194	8,2PF	0,5PF	500	C602
4822 122 31063	22PF	2	100	C604
4822 122 31063	22PF	2	100	C606
4822 122 30091	390PF	2	100	C607
4822 122 30103	22NF	−20+80	40	C608
4822 122 30128	4,7NF	10	100	C610
4822 122 30045	27PF	2	100	C611
4822 122 30103	22NF	−20+80	40	C612
4822 122 30103	22NF	−20+80	40	C613
4822 122 30103	22NF	−20+80	40	C614
4822 122 30103	22NF	−20+80	40	C616
4822 122 30045	27PF	2	100	C617
4822 122 31054	10PF	2	100	C618
4822 122 31054	10PF	2	100	C619
4822 122 31063	22PF	2	100	C620
4822 122 30103	22NF	−20+80	40	C621
4822 122 30103	22NF	−20+80	40	C622
4822 122 30103	22NF	−20+80	40	C623
4822 122 30103	22NF	−20+80	40	C624
4822 122 30043	10NF	−20+80	40	C625
4822 122 30103	22NF	−20+80	40	C626
4822 122 30103	22NF	−20+80	40	C627
4822 122 30103	22NF	−20+80	40	C629
4822 122 31049	6,8PF	0,25PF	100	C630
4822 122 30103	22NF	−20+80	40	C631
4822 122 30045	27PF	2	100	C634
4822 122 30045	27PF	2	100	C635
4822 122 30103	22NF	−20+80	40	C636
4822 122 30103	22NF	−20+80	40	C637
4822 122 30103	22NF	−20+80	40	C638
4822 122 30103	22NF	−20+80	40	C639
4822 122 30103	22NF	−20+80	40	C642
5322 124 10014	4,7UF		35	C643
4822 124 20475	10UF	−10+50	25	C644
4822 122 30043	10NF	−20+80	40	C645
4822 124 20459	22UF	−10+50	10	C646
4822 124 20475	10UF	−10+50	25	C647
4822 124 20459	22UF	−10+50	10	C648
4822 122 30043	10NF	−20+80	40	C649
4822 122 30043	10NF	−20+80	40	C652
4822 124 20459	22UF	−10+50	10	C800
4822 122 31058	15PF	2	100	C801
4822 122 30103	22NF	−20+80	40	C802
4822 122 30045	27PF	2	100	C803
4822 122 30103	22NF	−20+80	40	C804
5322 121 54062	4,3NF	1	63	C805
4822 121 50549	442PF	1	250	C806
5322 121 40224	4,7UF	10	300	C807
5322 121 54108	47NF	1	63	C808
5322 124 14057	100UF		10	C809
4822 122 30103	22NF	−20+80	40	C810
4822 121 40427	220N	10	100	C811
4822 122 30128	4,7NF	10	100	C812
4822 122 30103	22NF	−20+80	40	C813
4822 122 30103	22NF	−20+80	40	C814
4822 122 30103	22NF	−20+80	40	C815
4822 122 31221	1,5NF	10	100	C816
4822 122 30103	22NF	−20+80	40	C818
4822 124 20475	10UF	−10+50	25	C819
4822 124 20459	22UF	−10+50	10	C820
4822 122 30043	10NF	−20+80	40	C821
4822 124 20475	10UF	−10+50	25	C822
4822 124 20459	22UF	−10+50	10	C823
4822 122 30103	22NF	−20+80	40	C824

SERV. CODE	VALUE	TOL. (%)	V	POS
4822 122 31219	150PF	10	500	C825
4822 122 30103	22NF	−20+80	40	C827
4822 122 31192	6,8PF	0,5PF	500	C1001
4822 122 31194	8,2PF	0,5PF	500	C1002
4822 122 31063	22PF	2	100	C1004
4822 122 31063	22PF	2	100	C1006
4822 122 30091	390PF	2	100	C1007
4822 122 30103	22NF	−20+80	40	C1008
4822 122 30128	4,7NF	10	100	C1010
4822 122 30045	27PF	2	100	C1011
4822 122 30103	22NF	−20+80	40	C1013
4822 122 30103	22NF	−20+80	40	C1014
4822 122 30045	27PF	2	100	C1017
4822 122 31054	10PF	2	100	C1018
4822 122 31054	10PF	2	100	C1019
4822 122 31063	22PF	2	100	C1020
4822 122 30103	22NF	−20+80	40	C1021
4822 122 30103	22NF	−20+80	40	C1022
4822 122 30103	22NF	−20+80	40	C1023
4822 122 30103	22NF	−20+80	40	C1024
4822 122 30103	22NF	−20+80	40	C1026
4822 122 30103	22NF	−20+80	40	C1027
4822 122 30103	22NF	−20+80	40	C1029
4822 122 31061	18PF	2	100	C1030
4822 122 30103	22NF	−20+80	40	C1031
4822 122 30045	27PF	2	100	C1034
4822 122 30045	27PF	2	100	C1035
4822 122 30103	22NF	−20+80	40	C1036
4822 122 30103	22NF	−20+80	40	C1037
4822 122 30103	22NF	−20+80	40	C1038
4822 122 30103	22NF	−20+80	40	C1039
4822 122 30103	22NF	−20+80	40	C1040
4822 122 30043	10NF	−20+80	40	C1041
4822 121 41161	100NF	10	250	C1042
4822 124 20475	10UF	−10+50	25	C1044
4822 122 30043	10NF	−20+80	40	C1045
4822 124 20459	22UF	−10+50	10	C1046
4822 124 20475	10UF	−10+50	25	C1047
4822 124 20459	22UF	−10+50	10	C1048
4822 122 30043	10NF	−20+80	40	C1049
4822 122 30103	22NF	−20+80	40	C1051
4822 122 30043	10NF	−20+80	40	C1052
4822 122 30043	10NF	−20+80	40	C1053
4822 122 31081	100PF	2	100	C1054
5322 121 54108	47NF	1	63	C1200
4822 122 31058	15PF	2	100	C1201
4822 121 50549	442P	1	250	C1202
5322 121 40224	4,7UP	10	100	C1203
5322 121 54062	4,3NF	1	63	C1204
4822 122 30103	22NF	−20+80	40	C1205
4822 122 30103	22NF	−20+80	40	C1206
4822 122 30103	22NF	−20+80	40	C1207
4822 122 31221	1,5NF	10	100	C1208
4822 122 31063	22PF	2	100	C1209
4822 122 30103	22NF	−20+80	40	C1210
4822 122 30045	27PF	2	100	C1211
4822 124 20475	10UF	−10+50	25	C1212
4822 124 20459	22UF	−10+50	10	C1213
4822 124 20475	10UF	−10+50	25	C1214
4822 124 20459	22UF	−10+50	10	C1216
4822 122 30103	22NF	−20+80	40	C1217
4822 122 31063	22PF	2	100	C1218
4822 122 31063	22PF	2	100	C1219
4822 121 41161	100NF	10	250	C1221
4822 122 31081	100PF	2	100	C1222
4822 122 30043	10NF	−20+80	40	C1404
4822 122 30043	10NF	−20+80	40	C1406
4822 122 30043	10NF	−20+80	40	C1407
4822 122 30043	10NF	−20+80	40	C1408
4822 122 30043	10NF	−20+80	40	C1409
4822 121 41161	100NF	10	250	C1410
4822 122 30043	10NF	−20+80	40	C1411

SERV. CODE	VALUE	TOL. (%)	V	POS
4822 122 30043	10NF	-20+80	40	C1412
4822 122 30043	10NF	-20+80	40	C1413
4822 122 30043	10NF	-20+80	40	C1414
4822 121 41161	100NF	10	250	C1415
4822 122 30043	10NF	-20+80	40	C1416
4822 122 30043	10NF	-20+80	40	C1417
4822 122 30043	10NF	-20+80	40	C1418
4822 122 30043	10NF	-20+80	40	C1419
4822 122 30043	10NF	-20+80	40	C1420
4822 122 30043	10NF	-20+80	40	C1421
4822 122 30043	10NF	-20+80	40	C1422
4822 122 30043	10NF	-20+80	40	C1423
4822 122 30043	10NF	-20+80	40	C1424
4822 122 30135	820PF	10	100	C1602
4822 122 31069	39PF	2	100	C1603
4822 122 30043	10NF	-20+80	40	C1604
4822 122 31081	100PF	2	100	C1605
4822 124 20589	220UF	-10+50	10	C1606
4822 124 20589	220UF	-10+50	10	C1607
4822 122 31175	1NF	10	100	C1608
4822 122 30103	22NF	-20+80	40	C1609
4822 122 30045	27PF	2	100	C1611
4822 122 31116	2,2NF	10	500	C1701
5322 122 34039	0,56PF	0,25PF	100	C1702
5322 125 50048	3,5PF		300	C1703
4822 122 30103	22NF	-20+80	40	C1704
4822 121 41161	100NF	10	250	C1706
5322 125 50048	3,5PF		300	C1707
5322 122 34039	0,56PF	0,25PF	100	C1708
4822 122 31116	2,2NF	10	500	C1709
4822 122 30103	22NF	-20+80	40	C1711
4822 121 41161	100NF	10	250	C1712
4822 122 30103	22NF	-20+80	40	C1713
4822 121 40239	47NF	10	250	C1714
4822 122 30103	22NF	-20+80	40	C1716
4822 121 40239	47NF	10	250	C1717
4822 124 20475	10UF	-10+50	25	C1718
4822 121 41161	100NF	10	250	C1800
5322 121 44142	220NF	10	250	C1801
5322 122 44009	2,2NF	20	250	C1802
5322 122 44009	2,2NF	20	250	C1803
5322 121 44142	220NF	10	250	C1804
4822 121 40427	220NF	10	250	C1805
4822 124 40066	30+50UF		400	C1806
4822 124 40066	50+50UF		400	C1807
4822 124 20462	100UF	-10+50	10	C1808
5322 124 24153	220UF		100	C1809
5322 124 24212	220UF	-20+20	6,3	C1810
4822 121 40239	47NF	10	100	C1811
4822 124 20581	200UF	-10+50	4	C1812
4822 122 30128	4,7NF	10	100	C1813
4822 124 20467	15UF	-10+50	16	C1814
4822 121 40208	1UF	10	100	C1815
4822 121 40104	150NF	10	250	C1816
4822 121 40452	1,5UF	10	100	C1817
4822 124 20483	6,8UF	-10+50	40	C1818
4822 121 41169	220NF	10	250	C1819
4822 122 31175	1NF	10	100	C1820
4822 121 40407	22NF	10	250	C1821
4822 121 41169	220NF	10	250	C1822
4822 121 41161	100NF	10	250	C1823
5322 124 24107	220UF	-20+20	10	C1824
5322 122 54006	3,3NF	-20+50	3K	C1825
4822 121 41161	100NF	10	250	C1826
4822 121 41161	100NF	10	250	C1827
4822 121 41161	100NF	10	250	C1828
4822 121 41161	100NF	10	250	C1829
4822 121 40104	150NF	10	250	C1830
4822 124 20501	47UF	-10+50	63	C1831
4822 124 20497	15UF	-10+50	63	C1832
4822 124 20488	100UF	-10+50	40	C1833
4822 124 20485	33UF	-10+50	40	C1834

SERV. CODE	VALUE	TOL. (%)	V	POS
4822 121 40239				C1835
4822 124 20488	100UF	-10+50	40	C1836
4822 124 20485	33UF	-10+50	40	C1837
4822 121 41161	100NF	10	250	C1840
4822 124 20469	68UF	-10+50	16	C1842
4822 124 20454	150UF	-10+50	6,3	C1843
4822 124 20454	150UF	-10+50	6,3	C1844
4822 121 40411	33NF	10	400	C1845
4822 124 20454	150UF	-10+50	6,3	C1846
4822 124 20454	150UF	-10+50	6,3	C1847
4822 122 31177	470PF	10	500	C1849
4822 122 30128	4,7NF	10	100	C1851
4822 124 20468	33UF	-10+50	16	C1901
5322 121 40233	680NF	10	100	C1902
4822 121 50611	20NF	1	63	C1903
4822 124 20453	68UF	-10+50	6,3	C1904
4822 124 20497	15UF	-10+50	63	C2000
4822 124 20501	47UF	-10+50	63	C2001
5322 122 30134	10NF	-20+50	3K	C2002
4822 121 40427	220NF	10	100	C2003
4822 121 40411	33NF	10	250	C2004
4822 122 31175	1NF	10	100	C2006
4822 121 40443	680NF	10	100	C2007
4822 124 20462	100UF	-10+50	10	C2101
4822 122 30103	22NF	-20+80	40	C2102
4822 122 30043	10NF	-20+80	40	C2201
4822 122 30034	470PF	10	100	C2202
4822 124 20583	1UF	-10+50	63	C2203
4822 124 20452	33UF	-10+50	6,3	C2204
4822 122 30103	22NF	-20+80	40	C2206
4822 122 31063	22PF	2	100	C2301
4822 124 20467	15UF	-10+50	16	C2302
4822 124 20462	100UF	-10+50	10	C2303
4822 122 30043	10NF	-20+80	40	C2304
4822 122 30043	10NF	-20+80	40	C2306
4822 122 30043	10NF	-20+80	40	C2307
4822 124 20589	220UF	-10+50	10	C2308
4822 122 30027	1NF	-20+80	40	C2400
4822 122 30103	22NF	-20+80	40	C2401
4822 122 30095	270PF	2	100	C2402
4822 122 30103	22NF	-20+80	40	C2403
4822 122 30103	22NF	-20+80	40	C2404
4822 122 30103	22NF	-20+80	40	C2405
4822 124 20454	150UF	-10+50	6,3	C2406
4822 122 30103	22NF	-20+80	40	C2407
4822 122 30103	22NF	-20+80	40	C2408
4822 122 30103	22NF	-20+80	40	C2409
4822 122 30103	22NF	-20+80	40	C2410
4822 122 30103	22NF	-20+80	40	C2411
4822 122 30103	22NF	-20+80	40	C2412
4822 122 30103	22NF	-20+80	40	C2413
4822 122 30103	22NF	-20+80	40	C2414
4822 122 30094	220PF	2	100	C2415
4822 122 31173	220PF	10	100	C2416
4822 122 31195	10PF	2	500	C2501
4822 121 40407	22NF	10	400	C2502
5322 125 50051	18PF		300	C2503
4822 122 31074	56PF	2	100	C2504
4822 122 30103	22NF	-20+80	40	C2506
4822 122 31172	180PF	10	100	C2507
4822 122 30103	22NF	-20+80	40	C2508
4822 122 31195	10PF	2	500	C2509

RESISTORS

SERV. CODE	VALUE	TOL. (%)	V	POS
5322 103 54027	5K	5	2W	R1
5322 101 44015	50K	20		R2
5322 101 24056	1K	20	0.1W	R3
5322 100 10135	470	20	0.75W	R4
5322 100 10143	1K	20	0.75W	R5
5322 101 24056	1K	20	0.1W	R7
5322 101 64011	100K	20	0.1W	R8
5322 101 44014	100K	20		R9
5322 101 64011	100K	20	0.1W	R10
5322 101 24047	22K	20	0.1W	R11
5322 101 40041	4,7K	20	0.25W	R13
5322 101 40041	4,7K	20	0.25W	R14
5322 101 24099	10K	20	0.1W	R15
5322 101 24065	4,7K	20	0.1W	R16
5322 101 24055	25K	20		R19
5322 101 24147	22K	20	0.1W	R20
5322 101 24147	22K	20	0.1W	R21
5322 101 24054	10K	20		R22
5322 116 64048	56	5	0.125W	R101
5322 116 55218	920K	0,5	MR30	R102
5322 116 64052	39	5	0.125W	R103
5322 116 55067	88,9K	0,25	MR24C	R104
5322 116 64069	43	5	0.125W	R106
5322 116 55239	200K	0,5	MR25	R107
5322 116 64045	10	5	0.125W	R108
5322 116 64047	560	5	0.125W	R109
5322 116 64047	560	5	0.125W	R111
5322 116 64069	43	5	0.125W	R112
5322 116 55153	992K	0,5	SPEC	R113
5322 116 64049	47	5	0.125W	R114
5322 116 55066	8,08K	0,25	MR24C	R116
5322 116 64051	15	5	0.125W	R117
5322 116 64051	15	5	0.125W	R118
5322 111 30376	100M	5	0,125W	R119
5322 116 50729	4,22K	1	MR25	R121
5322 116 54632	14,7K	1	MR25	R122
5322 116 54536	750	1	MR25	R123
5322 116 54208	210K	1	MR25	R124
5322 116 64052	39	5	0.125W	R125
5322 116 54774	590K	1	MR30	R126
5322 116 54696	100K	1	MR25	R127
4822 110 53214	10M	10	CR37	R128
5322 100 10143	1K	20	0.75W	R129
5322 116 54208	210K	1	MR25	R131
5322 100 10141	10K	20	0.75W	R132
4822 110 42227	33M	5	VR37	R134
5322 116 54469	100	1	MR25	R139
5322 116 50592	442	1	MR25	R148
5322 116 50592	442	1	MR25	R149
5322 116 54499	249	1	MR25	R151
5322 116 50767	2,15K	1	MR25	R200
4822 111 30324	100	5	CR16	R205
4822 111 30324	100	5	CR16	R210
5322 116 54549	1K	1	MR25	R215
5322 100 10139	4,7K	20	0.75W	R220
5322 111 34165	200K	5	CR16	R300
5322 101 14069	22K	20	0.5W	R301
5322 116 54608	7,5K	1	MR25	R302
5322 116 50586	1,54K	1	MR25	R303
5322 101 14047	470	20	0.5W	R304
5322 116 54571	1,96K	1	MR25	R306
5322 116 50524	3,01K	1	MR25	R307
5322 116 54585	3,48K	1	MR25	R308
5322 116 54532	649	1	MR25	R309
5322 101 14047	470	20	0.5W	R311
5322 116 54549	1K	1	MR25	R312
5322 116 50729	4,22K	1	MR25	R314
5322 116 54516	365	1	MR25	R315
5322 100 10143	1K	20	0.75W	R316
5322 116 54576	2,37K	1	MR25	R317
5322 101 14042	22K	20	0.75W	R318

SERV. CODE	VALUE	TOL. (%)	V	POS
5322 116 54549	1K	1	MR25	R319
4822 116 30018	1,3K	10	1W	R320
5322 116 54585	3,48K	1	MR25	R321
5322 116 54532	649	1	MR25	R322
5322 100 10143	1K	20	0.75W	R323
5322 116 54469	100	1	MR25	R324
5322 116 54558	8,25K	1	MR25	R325
5322 116 54472	105	1	MR25	R326
5322 116 50414	2,87K	1	MR25	R327
5322 116 54469	100	1	MR25	R328
5322 116 50414	2,87K	1	MR25	R329
5322 116 50669	205	1	MR25	R331
5322 116 54549	1K	1	MR25	R332
5322 101 14069	22K	20	0.5W	R333
5322 116 54585	3,48K	1	MR25	R334
5322 116 54459	75	1	MR25	R335
5322 116 50664	2,05K	1	MR25	R336
5322 116 54549	1K	1	MR25	R337
5322 116 50509	4,87K	1	MR25	R338
5322 116 50509	4,87K	1	MR25	R339
5322 116 54549	1K	1	MR25	R340
5322 116 54549	1K	1	MR25	R341
5322 116 54557	1,21K	1	MR25	R342
5322 116 54519	402	1	MR25	R343
5322 116 50491	22,6	1	MR25	R344
5322 116 54469	100	1	MR25	R345
5322 116 50459	422	1	MR25	R346
5322 116 50583	5,9K	1	MR25	R347
5322 116 54608	7,5K	1	MR25	R348
5322 116 50728	1,87K	1	MR25	R349
5322 111 34165	200K	5	CR16	R350
5322 101 14069	22K	20	0.5W	R351
5322 116 54608	7,5K	1	MR25	R352
5322 116 50586	1,54K	1	MR25	R353
5322 101 14047	470	20	0.5W	R354
5322 116 54571	1,96K	1	MR25	R356
5322 116 50524	3,01K	1	MR25	R357
5322 116 54585	3,48K	1	MR25	R358
5322 116 54532	649	1	MR25	R359
5322 101 14047	470	20	0.5W	R361
5322 116 54549	1K	1	MR25	R362
5322 100 10143	1K	20	0.75W	R363
5322 116 50729	4,22K	1	MR25	R364
5322 116 54516	365	1	MR25	R365
5322 100 10143	1K	20	0.75W	R366
5322 116 54576	2,37K	1	MR25	R367
5322 101 14042	22K	20	0.75W	R368
5322 116 54549	1K	1	MR25	R369
4822 116 30018	1,3K	10	1W	R370
5322 116 54585	3,48K	1	MR25	R371
5322 116 54532	649	1	MR25	R372
5322 100 10143	1K	20	0.75W	R373
5322 116 54469	100	1	MR25	R374
5322 116 54558	8,25K	1	MR25	R375
5322 116 54472	105	1	MR25	R376
5322 116 50414	2,87K	1	MR25	R377
5322 116 54469	100	1	MR25	R378
5322 116 50414	2,87K	1	MR25	R379
5322 116 50669	205	1	MR25	R381
5322 116 54549	1K	1	MR25	R382
5322 101 14069	22K	20	0.5W	R383
5322 116 54585	3,48K	1	MR25	R384
5322 116 50664	2,05K	1	MR25	R386
5322 116 54549	1K	1	MR25	R387
5322 116 50509	4,87K	1	MR25	R388
5322 116 50509	4,87K	1	MR25	R389
5322 116 54549	1K	1	MR25	R391
5322 116 54557	1,21K	1	MR25	R392
5322 116 54519	402	1	MR25	R393
5322 116 50491	22,6	1	MR25	R394
5322 116 54469	100	1	MR25	R395
5322 116 54459	75	1	MR25	R396

SERV. CODE	DESCR		POS
5322 116 54536	750	1	MR25 R400
5322 116 54448	59	1	MR25 R401
5322 116 54448	59	1	MR25 R402
5322 116 50729	4,22K	1	MR25 R403
5322 116 50524	3,01K	1	MR25 R404
5322 116 50508	487	1	MR25 R405
5322 100 10141	10K	20	0.75W R406
5322 116 50479	15,4K	1	MR25 R407
5322 100 10138	100	20	0.75W R408
5322 101 14056	47K	20	0.75W R409
5322 101 14056	47K	20	0.75W R410
5322 116 50767	2,15K	1	MR25 R411
5322 116 54696	100K	1	MR25 R412
5322 116 54696	100K	1	MR25 R413
5322 116 50767	2,15K	1	MR25 R414
5322 111 30378	200	5	CR16 R417
5322 116 64005	200	5	5E R418
5322 116 54466	90,9	1	MR25 R419
5322 116 54466	90,9	1	MR25 R421
5322 116 50592	442	1	MR25 R422
5322 101 14093	50	20	0,5W R423
5322 116 54466	90,9	1	MR25 R424
5322 116 54466	90,9	1	MR25 R426
5322 116 64005	200	5	5E R427
5322 111 30378	200	5	CR16 R428
5322 116 50664	2,05K	1	MR25 R429
5322 116 54603	6,49K	1	MR25 R430
5322 100 10141	10K	20	0.75W R432
5322 116 54536	750	1	MR25 R433
5322 116 54536	750	1	MR25 R434
5322 116 54565	1,62K	1	MR25 R436
5322 116 54442	51,1	1	MR25 R506
5322 116 54442	51,1	1	MR25 R507
5322 116 54562	1,4K	1	MR25 R508
5322 116 50557	46,4K	1	MR25 R509
5322 116 54743	301K	1	MR25 R511
5322 116 54623	11K	1	MR25 R512
5322 116 50635	1,47K	1	MR25 R513
5322 116 54005	3,32K	1	MR25 R514
5322 116 54005	3,32K	1	MR25 R516
5322 116 50664	2,05K	1	MR25 R517
5322 116 54661	34,8K	1	MR25 R518
5322 116 54536	750	1	MR25 R519
4822 110 63036	2,2	5	CR25 R520
5322 116 54689	82,5K	1	MR25 R521
5322 116 50492	46,4	1	MR25 R522
5322 116 54462	82,5	1	MR25 R523
5322 116 50524	3,01K	1	MR25 R524
5322 116 50536	464	1	MR25 R525
5322 116 50492	46,4	1	MR25 R526
5322 116 50492	46,4	1	MR25 R528
5322 116 55151	464	1	MR30 R529
5322 116 50491	22,6	1	MR25 R530
5322 116 54635	16,9K	1	MR25 R531
5322 116 54665	40,2K	1	MR25 R532
5322 116 50767	2,15K	1	MR25 R533
5322 116 50559	27,4K	1	MR25 R534
5322 116 50608	6,19K	1	MR25 R536
5322 116 54005	3,32K	1	MR25 R537
5322 116 54623	11K	1	MR25 R538
5322 116 50536	464	1	MR25 R540
5322 116 54689	82,5K	1	MR25 R541
5322 116 50536	464	1	MR25 R542
5322 116 54623	11K	1	MR25 R543
5322 116 50557	46,4K	1	MR25 R544
5322 116 54627	13,3K	1	MR25 R546
5322 101 14069	22K	20	0.5W R547
5322 116 54576	2,37K	1	MR25 R548
5322 116 50608	6,19K	1	MR25 R549
5322 116 54619	10K	1	MR25 R550
5322 116 54005	3,32K	1	MR25 R551
5322 116 54623	11K	1	MR25 R552
5322 116 54689	82,5K	1	MR25 R553
5322 116 54623	11K	1	MR25 R554
5322 116 50536	464	1	MR25 R555
5322 116 50557	46,4K	1	MR25 R556
5322 116 50536	464	1	MR25 R557
5322 116 50557	46,4K	1	MR25 R558
5322 116 54623	11K	1	MR25 R559
5322 116 54743	301K	1	MR25 R560
5322 116 54619	10K	1	MR25 R561
5322 116 54641	19,6K	1	MR25 R562
5322 116 50729	4,22K	1	MR25 R563
4822 110 63187	1M	5	CR25 R564
5322 116 54549	1K	1	MR25 R565
4822 110 63187	1M	5	CR25 R566
4822 110 63161	100K	5	CR25 R567
5322 101 14094	1M	20	0,5W R568
4822 110 63187	1M	5	CR25 R569
4822 110 63107	1K	5	CR25 R570
4822 110 63187	1M	5	CR25 R571
5322 116 54619	10K	1	MR25 R572
4822 110 42223	22M	5	VR37 R573
4822 110 42216	12M	5	VR37 R574
5322 116 64029	5,6M	5	VR68 R575
4822 110 42205	4,7M	5	VR37 R576
4822 110 63196	2,2M	10	CR25 R577
4822 110 63196	2,2M	10	CR25 R578
5322 101 14094	1M	20	0,5W R579
5322 116 54549	1K	1	MR25 R580
5322 116 54619	10K	1	MR25 R581
5322 116 54701	110K	1	MR25 R582
5322 116 54701	110K	1	MR25 R583
5322 116 54674	53,6K	1	MR25 R584
5322 116 50491	22,6	1	MR25 R585
5322 116 54674	53,6K	1	MR25 R586
5322 101 14048	47K	20	0.5W R587
5322 101 14048	47K	20	0.5W R588
5322 101 14048	47K	20	0.5W R589
4822 111 30324	100	5	CR16 R590
5322 116 54469	100	1	MR25 R591
5322 116 54492	178	1	MR25 R592
5322 116 54946	64,9	1	MR30 R593
5322 116 55026	330	5	PR37 R594
5322 116 54589	3,83K	1	MR25 R595
5322 116 50675	2,26K	1	MR25 R596
4822 110 63107	1K	5	CR25 R597
5322 116 54721	178K	1	MR25 R602
5322 111 30396	22	5	CR16 R604
5322 116 54619	10K	1	MR25 R605
4822 110 63207	5,6M	10	CR25 R606
4822 110 63207	5,6M	10	CR25 R607
4822 111 30324	100	5	CR16 R608
5322 111 30396	22	5	CR16 R609
5322 116 54619	10K	1	MR25 R610
5322 116 54558	8,25K	1	MR25 R611
5322 116 54469	100	1	MR25 R612
5322 116 54541	825	1	MR25 R613
5322 116 50506	154	1	MR25 R614
5322 116 54497	226	1	MR25 R615
5322 116 54619	10K	1	MR25 R616
5322 116 50481	22,6K	1	MR25 R617
5322 116 54529	619	1	MR25 R618
4822 111 30348	27	5	CR16 R619
5322 116 50572	12,1K	1	MR25 R620
5322 111 30396	22	5	CR16 R621
5322 111 30074	56	5	CR16 R622
5322 116 54469	100	1	MR25 R623
5322 111 30074	56	5	CR16 R624
5322 100 10113	10K	20	0,5W R625
5322 116 54467	93,1	1	MR25 R626
5322 116 54529	619	1	MR25 R627
5322 116 54534	681	1	MR25 R628
5322 111 30288	47K	5	CR16 R632

SERV. CODE	DESCR		POS
4822 111 30348	27	5	CR16 R633
5322 116 54515	348	1	MR25 R634
5322 111 30074	56	5	CR16 R635
5322 100 10113	10K	20	0,5W R636
5322 116 50524	3,01K	1	MR25 R637
5322 111 30074	56	5	CR16 R638
5322 116 54534	681	1	MR25 R639
5322 116 50561	590	1	MR25 R641
5322 116 54469	100	1	MR25 R642
5322 111 30074	56	5	CR16 R643
5322 116 50524	3,01K	1	MR25 R644
5322 111 30074	56	5	CR16 R645
5322 116 50524	3,01K	1	MR25 R646
4822 111 30348	27	5	CR16 R647
5322 111 30074	56	5	CR16 R648
5322 116 54469	100	1	MR25 R649
5322 111 30074	56	5	CR16 R650
5322 116 50561	590	1	MR25 R651
5322 111 30074	56	5	CR16 R652
5322 116 54534	681	1	MR25 R653
5322 116 50524	3,01K	1	MR25 R654
5322 111 30074	56	5	CR16 R655
5322 100 10113	10K	20	0,5W R656
5322 116 50506	154	1	MR25 R657
4822 111 30348	27	5	CR16 R658
5322 101 14066	10K	20	0.5W R669
5322 111 30074	56	5	CR16 R671
5322 116 54469	100	1	MR25 R672
5322 116 50561	590	1	MR25 R673
5322 111 30074	56	5	CR16 R674
5322 116 54534	681	1	MR25 R676
5322 116 50491	22,6	1	MR25 R677
5322 116 50524	3,01K	1	MR25 R678
5322 116 54696	100K	1	MR25 R679
5322 111 30396	22	5	CR16 R680
5322 116 50524	3,01K	1	MR25 R681
5322 116 54541	825	1	MR25 R682
5322 116 50557	46,4K	1	MR25 R683
5322 116 54011	5,62K	1	MR25 R684
5322 116 50491	22,6	1	MR25 R685
5322 116 54696	100K	1	MR25 R686
5322 116 50515	1,78K	1	MR25 R687
5322 116 50767	2,15K	1	MR25 R688
5322 116 54549	1K	1	MR25 R689
5322 116 54549	1K	1	MR25 R691
5322 116 50484	4,64K	1	MR25 R692
5322 116 54619	10K	1	MR25 R693
5322 116 54549	1K	1	MR25 R694
5322 116 50515	1,78K	1	MR25 R696
5322 116 50767	2,15K	1	MR25 R697
5322 116 50524	3,01K	1	MR25 R698
5322 116 54541	825	1	MR25 R699
5322 111 30396	22	5	CR16 R700
5322 116 54529	619	1	MR25 R701
5322 116 54536	750	1	MR25 R702
5322 116 54554	1,1K	1	MR25 R703
5322 111 30396	22	5	CR16 R704
5322 116 50491	22,6	1	MR25 R705
4822 111 30067	33	5	CR16 R706
5322 116 50524	3,01K	1	MR25 R707
5322 116 50664	2,05K	1	MR25 R708
5322 100 10113	10K	20	0,5W R709
5322 116 54549	1K	1	MR25 R711
5322 101 14047	470	20	0,5W R712
5322 116 54619	10K	1	MR25 R713
5322 116 50586	1,54K	1	MR25 R714
5322 116 50484	4,64K	1	MR25 R716
5322 116 54549	1K	1	MR25 R717
5322 116 50586	1,54K	1	MR25 R718
5322 116 54529	619	1	MR25 R719
5322 116 54529	619	1	MR25 R721
5322 116 50572	12,1K	1	MR25 R722

SERV. CODE	DESCR		POS
5322 116 54549	1K	1	MR25 R723
5322 116 54529	619	1	MR25 R724
5322 116 54536	750	1	MR25 R726
5322 111 30396	22	5	CR16 R727
4822 111 30067	33	5	CR16 R728
5322 116 54554	1,1K	1	MR25 R729
5322 111 30396	22	5	CR16 R731
5322 111 30359	1,3K	5	CR16 R732
5322 111 30396	22	5	CR16 R733
5322 116 54585	3,48K	1	MR25 R734
4822 111 30347	10	5	CR16 R735
5322 116 54592	4,02K	1	MR25 R736
5322 101 14069	22K	20	0.5W R737
5322 116 54624	11,5K	1	MR25 R738
5322 116 50515	1,78K	1	MR25 R739
5322 116 54558	8,25K	1	MR25 R741
5322 116 54549	1K	1	MR25 R742
4822 111 30324	100	5	CR16 R743
5322 116 54592	4,02K	1	MR25 R744
4822 111 30439	20	5	CR16 R745
4822 111 30325	150	5	CR16 R746
5322 111 44153	15	5	CR16 R747
5322 116 54499	249	1	MR25 R748
5322 116 54515	348	1	MR25 R749
5322 111 30359	1,3K	5	CR16 R751
5322 111 44153	15	5	CR16 R752
5322 111 30396	22	5	CR16 R753
5322 111 30396	22	5	CR16 R754
4822 111 30347	10	5	CR16 R755
5322 111 30359	1,3K	5	CR16 R756
5322 116 50572	12,1K	1	MR25 R757
5322 116 50524	3,01K	1	MR25 R758
5322 116 50484	4,64K	1	MR25 R759
5322 116 50664	2,05K	1	MR25 R760
5322 116 54508	301	1	MR25 R761
5322 116 54565	1,62K	1	MR25 R762
5322 111 30297	2K	5	CR16 R763
5322 116 54469	100	1	MR25 R764
5322 116 54469	100	1	MR25 R765
4822 111 30272	680	5	CR16 R766
4822 110 63036	2,2	5	CR25 R767
4822 110 63036	2,2	5	CR25 R768
4822 110 63036	2,2	5	CR25 R769
4822 110 63036	2,2	5	CR25 R771
4822 111 30347	10	5	CR16 R801
5322 116 50904	30,1	1	MR25 R802
5322 116 54508	301	1	MR25 R803
5322 116 50675	2,26K	1	MR25 R804
5322 116 54624	11,5K	1	MR25 R805
5322 100 10113	10K	20	0,5W R806
5322 116 54619	10K	1	MR25 R807
5322 116 50414	2,87K	1	MR25 R808
5322 116 50608	6,19K	1	MR25 R809
5322 116 54511	316	1	MR25 R810
5322 116 54587	3,65K	1	MR25 R811
5322 116 54482	133	1	MR25 R812
5322 116 54558	8,25K	1	MR25 R813
5322 116 50506	154	1	MR25 R814
5322 116 54532	649	1	MR25 R815
5322 116 54696	100K	1	MR25 R816
5322 116 54619	10K	1	MR25 R817
5322 116 54549	1K	1	MR25 R818
5322 116 54442	51,1	1	MR25 R819
5322 116 50579	3,16K	1	MR25 R820
5322 116 54497	226	1	MR25 R821
5322 116 50491	22,6	1	MR25 R822
5322 116 50491	22,6	1	MR25 R823
5322 116 54595	5,11K	1	MR25 R824
5322 116 50452	10	1	MR25 R825
4822 111 30067	33	5	CR16 R826
5322 116 54619	10K	1	MR25 R827
5322 116 54608	7,5K	1	MR25 R828

SERV. CODE	DESCR		POS
5322 116 50664	2,05K	1	MR25 R829
5322 116 50636	2,74K	1	MR25 R831
5322 100 10114	4,7K	20	0.5W R834
5322 116 50481	22,6K	1	MR25 R836
5322 116 54632	14,7K	1	MR25 R837
5322 116 54721	178K	1	MR25 R838
5322 116 54479	127	1	MR25 R839
5322 116 50479	15,4K	1	MR25 R841
5322 116 54635	16,9K	1	MR25 R842
5322 116 54635	16,9K	1	MR25 R843
5322 116 50675	2,26K	1	MR25 R844
5322 116 50457	215	1	MR25 R846
5322 116 50414	2,87K	1	MR25 R847
5322 116 50509	4,87K	1	MR25 R848
5322 116 54562	1,4K	1	MR25 R849
5322 116 54009	562	1	MR25 R850
5322 116 54519	402	1	MR25 R851
5322 116 54532	649	1	MR25 R852
5322 116 50515	1,78K	1	MR25 R853
5322 116 50491	22,6	1	MR25 R854
5322 116 50559	27,4K	1	MR25 R855
5322 116 54009	562	1	MR25 R856
5322 116 54009	562	1	MR25 R857
5322 116 50559	27,4K	1	MR25 R858
5322 116 50559	27,4K	1	MR25 R859
5322 116 50675	2,26K	1	MR25 R860
5322 116 50675	2,26K	1	MR25 R861
5322 116 50675	2,26K	1	MR25 R862
5322 116 50636	2,74K	1	MR25 R863
5322 116 50636	2,74K	1	MR25 R864
5322 116 50636	2,74K	1	MR25 R865
5322 116 50452	10	1	MR25 R866
5322 116 50491	22,6	1	MR25 R867
5322 116 54641	19,6K	1	MR25 R868
5322 116 54585	3,48K	1	MR25 R869
5322 116 54005	3,32K	1	MR25 R870
5322 116 50726	36,5K	1	MR25 R871
5322 116 50726	36,5K	1	MR25 R872
5322 116 50491	22,6	1	MR25 R873
5322 116 50491	22,6	1	MR25 R874
4822 111 30311	3,9K	5	CR16 R875
4822 111 30245	47	5	CR16 R876
4822 111 30352	82	5	CR16 R877
5322 111 30279	33K	5	CR16 R878
5322 116 54655	30,1K	1	MR25 R881
5322 116 54549	1K	1	MR25 R882
5322 116 50536	464	1	MR25 R883
5322 116 54619	10K	1	MR25 R889
5322 116 50508	487	1	MR25 R891
5322 116 54637	17,8K	1	MR25 R893
5322 116 50572	12,1K	1	MR25 R894
5322 116 54689	82,5K	1	MR25 R896
5322 116 54608	7,5K	1	MR25 R897
5322 116 50592	442	1	MR25 R898
5322 116 54643	20,5K	1	MR25 R899
4822 110 63036	2,2	5	CR25 R901
4822 110 63036	2,2	5	CR25 R902
4822 110 63036	2,2	5	CR25 R903
4822 110 63036	2,2	5	CR25 R904
5322 116 54902	876K	0,25	MR54C R921
5322 116 54901	887K	0,25	MR54C R922
5322 116 54896	354K	0,25	MR34C R923
5322 116 54899	176K	0,25	MR34C R924
5322 116 54897	87,6K	0,25	MR24C R926
5322 116 54895	34,6K	0,25	MR24C R927
5322 116 54894	16,8K	0,25	MR24C R928
5322 116 55161	7,96K	0,25	MR24C R929
5322 116 50784	2,67K	0,25	MR24C R931
5322 116 54898	887	0,25	MR24C R932
5322 116 51052	42,2	1	MR25 R1000
5322 116 54195	825K	1	MR30 R1001
5322 116 54721	178K	1	MR25 R1002

SERV. CODE	DESCR		POS
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4822 110 63207	5,6M	10	CR25 R1007
4822 111 30324	100	5	CR16 R1008
5322 111 30396	22	5	CR16 R1009
5322 116 54619	10K	1	MR25 R1010
5322 116 54541	825	1	MR25 R1013
5322 116 50506	154	1	MR25 R1014
5322 116 54497	226	1	MR25 R1015
5322 116 54529	619	1	MR25 R1018
4822 111 30348	27	5	CR16 R1019
5322 116 50572	12,1K	1	MR25 R1020
5322 111 30074	56	5	CR16 R1022
5322 116 54469	100	1	MR25 R1023
5322 111 30074	56	5	CR16 R1024
5322 100 10113	10K	20	0,5W R1025
5322 116 54469	100	1	MR25 R1026
5322 116 54529	619	1	MR25 R1027
5322 116 54534	681	1	MR25 R1028
5322 111 30288	47K	5	CR16 R1032
4822 111 30348	27	5	CR16 R1033
5322 111 30074	56	5	CR16 R1035
5322 100 10113	10K	20	0,5W R1036
5322 116 50524	3,01K	1	MR25 R1037
5322 111 30074	56	5	CR16 R1038
5322 116 54534	681	1	MR25 R1039
5322 116 50561	590	1	MR25 R1041
5322 116 54469	100	1	MR25 R1042
5322 111 30074	56	5	CR16 R1043
5322 116 50524	3,01K	1	MR25 R1044
5322 111 30074	56	5	CR16 R1045
5322 116 50524	3,01K	1	MR25 R1046
4822 111 30348	27	5	CR16 R1047
5322 111 30074	56	5	CR16 R1048
5322 116 54469	100	1	MR25 R1049
5322 111 30074	56	5	CR16 R1050
5322 116 50561	590	1	MR25 R1051
5322 111 30074	56	5	CR16 R1052
5322 116 54534	681	1	MR25 R1053
5322 116 50524	3,01K	1	MR25 R1054
5322 111 30074	56	5	CR16 R1055
5322 100 10113	10K	20	0,5W R1056
5322 116 50506	154	1	MR25 R1057
4822 111 30348	27	5	CR16 R1058
5322 116 54696	100K	1	MR25 R1079
5322 111 30396	22	5	CR16 R1080
5322 116 50524	3,01K	1	MR25 R1081
5322 116 54541	825	1	MR25 R1082
5322 116 50557	46,4K	1	MR25 R1083
5322 116 54011	5,62K	1	MR25 R1084
5322 116 54696	100K	1	MR25 R1086
5322 116 50515	1,78K	1	MR25 R1087
5322 116 50767	2,15K	1	MR25 R1088
5322 116 54549	1K	1	MR25 R1089
5322 116 54549	1K	1	MR25 R1091
5322 116 50484	4,64K	1	MR25 R1092
5322 116 54619	10K	1	MR25 R1093
5322 116 54549	1K	1	MR25 R1094
5322 116 50515	1,78K	1	MR25 R1096
5322 116 50767	2,15K	1	MR25 R1097
5322 116 50524	3,01K	1	MR25 R1098
5322 116 54541	825	1	MR25 R1099
5322 111 30396	22	5	CR16 R1100
5322 116 54529	619	1	MR25 R1101
5322 116 54536	750	1	MR25 R1102
5322 116 54554	1,1K	1	MR25 R1103
5322 111 30396	22	5	CR16 R1104
5322 116 50491	22,6	1	MR25 R1105
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5322 116 54529	619	1	MR25 R1107
5322 116 50572	12,1K	1	MR25 R1108
5322 100 10113	10K	20	0,5W R1109

SERV. CODE	DESCR		POS
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5322 116 50586	1,54K	1	MR25 R1114
5322 116 50484	4,64K	1	MR25 R1116
5322 116 54549	1K	1	MR25 R1117
5322 116 50586	1,54K	1	MR25 R1118
5322 116 50586	1,54K	1	MR25 R1119
5322 116 54529	619	1	MR25 R1121
5322 116 50664	2,05K	1	MR25 R1122
5322 116 54549	1K	1	MR25 R1123
5322 116 54529	619	1	MR25 R1124
5322 116 50491	22,6	1	MR25 R1125
5322 116 54536	750	1	MR25 R1126
5322 111 30396	22	5	CR16 R1127
4822 111 30067	33	5	CR16 R1128
5322 116 54554	1,1K	1	MR25 R1129
5322 116 50508	487	1	MR25 R1130
5322 111 30396	22	5	CR16 R1131
4822 111 30352	82	5	CR16 R1132
5322 111 30396	22	5	CR16 R1133
5322 116 54585	3,48K	1	MR25 R1134
4822 111 30347	10	5	CR16 R1135
5322 116 54592	4,02K	1	MR25 R1136
5322 101 14069	22K	20	0.5W R1137
5322 116 54624	11,5K	1	MR25 R1138
5322 116 50515	1,78K	1	MR25 R1139
4822 111 30069	39	5	CR16 R1140
5322 116 54558	8,25K	1	MR25 R1141
5322 116 54549	1K	1	MR25 R1142
5322 116 54469	100	1	MR25 R1143
5322 116 54592	4,02K	1	MR25 R1144
5322 111 30365	51	5	CR16 R1145
5322 111 44153	15	5	CR16 R1146
5322 111 44153	15	5	CR16 R1147
5322 116 54515	348	1	MR25 R1148
5322 116 54515	348	1	MR25 R1149
4822 110 63036	2,2	5	CR25 R1150
5322 111 44153	15	5	CR16 R1151
5322 111 44153	15	5	CR16 R1152
5322 111 30396	22	5	CR16 R1153
5322 111 30396	22	5	CR16 R1154
4822 111 30347	10	5	CR16 R1155
4822 111 30352	82	5	CR16 R1156
5322 116 50572	12,1K	1	MR25 R1157
5322 116 50524	3,01K	1	MR25 R1158
5322 116 50484	4,64K	1	MR25 R1159
5322 116 54469	100	1	MR25 R1160
5322 116 54508	301	1	MR25 R1161
5322 116 54565	1,62K	1	MR25 R1162
4822 110 63036	2,2	5	CR25 R1167
4822 110 63036	2,2	5	CR25 R1168
4822 110 63036	2,2	5	CR25 R1169
4822 110 63036	2,2	5	CR25 R1171
4822 111 30347	10	5	CR16 R1201
5322 116 50904	30,1	1	MR25 R1202
5322 116 54508	301	1	MR25 R1203
5322 116 50675	2,26K	1	MR25 R1204
5322 116 54587	3,65K	1	MR25 R1205
5322 100 10113	10K	20	0,5W R1206
5322 116 54619	10K	1	MR25 R1207
5322 116 54617	9,53K	1	MR25 R1208
5322 116 54011	5,62K	1	MR25 R1209
5322 116 54525	511	1	MR25 R1210
5322 116 54547	953	1	MR25 R1211
5322 116 54442	51,1	1	MR25 R1212
5322 116 54558	8,25K	1	MR25 R1213
5322 116 54442	51,1	1	MR25 R1214
5322 116 54532	649	1	MR25 R1215
5322 116 50515	1,78K	1	MR25 R1216
5322 116 54442	51,1	1	MR25 R1217
5322 116 54442	51,1	1	MR25 R1219

SERV. CODE	DESCR		POS
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5322 116 54497	226	1	MR25 R1221
5322 116 50491	22,6	1	MR25 R1222
5322 116 50491	22,6	1	MR25 R1223
5322 116 54595	5,11K	1	MR25 R1224
5322 116 54009	562	1	MR25 R1225
5322 116 54689	82,5K	1	MR25 R1226
5322 100 10113	10K	20	0,5W R1227
4822 111 30067	33	5	CR16 R1228
5322 116 54619	10K	1	MR25 R1229
5322 116 50559	27,4K	1	MR25 R1230
5322 116 50636	2,74K	1	MR25 R1231
5322 116 54608	7,5K	1	MR25 R1232
5322 116 50664	2,05K	1	MR25 R1233
5322 100 10114	4,7K	20	0.5W R1234
5322 116 50675	2,26K	1	MR25 R1235
5322 116 50481	22,6K	1	MR25 R1236
5322 116 54009	562	1	MR25 R1237
5322 116 50559	27,4K	1	MR25 R1238
5322 116 50675	2,26K	1	MR25 R1239
5322 116 54009	562	1	MR25 R1241
5322 116 50559	27,4K	1	MR25 R1242
5322 116 50675	2,26K	1	MR25 R1243
5322 116 50491	22,6	1	MR25 R1244
5322 116 50491	22,6	1	MR25 R1246
4822 111 30245	47	5	CR16 R1247
4822 111 30352	82	5	CR16 R1248
5322 111 30279	33K	5	CR16 R1249
5322 116 54655	30,1K	1	MR25 R1251
5322 116 50457	215	1	MR25 R1252
5322 116 50675	2,26K	1	MR25 R1253
5322 116 50675	2,26K	1	MR25 R1254
5322 116 50509	4,87K	1	MR25 R1256
5322 116 54562	1,4K	1	MR25 R1257
5322 116 50621	536	1	MR25 R1258
5322 116 50508	487	1	MR25 R1259
5322 116 54576	2,37K	1	MR25 R1261
5322 116 54508	301	1	MR25 R1262
5322 116 54011	5,62K	1	MR25 R1263
5322 116 54567	1,69K	1	MR25 R1264
5322 111 30396	22	5	CR16 R1266
5322 116 50482	33,2K	1	MR25 R1267
5322 116 54608	7,5K	1	MR25 R1268
5322 111 30396	22	5	CR16 R1269
5322 116 50491	22,6	1	MR25 R1271
5322 116 54585	3,48K	1	MR25 R1272
5322 116 50558	18,7K	1	MR25 R1273
5322 116 54009	562	1	MR25 R1274
4822 110 63036	2,2	5	CR25 R1276
4822 110 63036	2,2	5	CR25 R1277
4822 110 63036	2,2	5	CR25 R1278
4822 110 63036	2,2	5	CR25 R1279
5322 116 50481	22,6K	1	MR25 R1280
5322 116 50586	1,54K	1	MR25 R1281
4822 111 30327	220	5	CR16 R1282
4822 111 30331	470	5	CR16 R1283
5322 116 54012	6,81K	1	MR25 R1284
5322 116 50556	4,42K	1	MR25 R1286
5322 116 54619	10K	1	MR25 R1287
5322 116 50524	3,01K	1	MR25 R1288
5322 116 54518	383	1	MR25 R1289
5322 116 54571	1,96K	1	MR25 R1291
5322 116 54571	1,96K	1	MR25 R1292
5322 116 54901	887K	0,25	MR54C R1302
5322 116 54896	354K	0,25	MR34C R1303
5322 116 54899	176K	0,25	MR34C R1304
5322 116 54897	87,6K	0,25	MR24C R1306
5322 116 54895	34,6K	0,25	MR24C R1307
5322 116 54894	16,8K	0,25	MR24C R1308
5322 116 55161	7,96K	0,25	MR24C R1309
5322 116 50784	2,67K	0,25	MR24C R1311
5322 116 54898	887	0,25	MR24C R1312

SERV. CODE	DESCR		POS
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5322 116 54558	8,25K	1	MR25 R1403
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5322 116 54009	562	1	MR25 R1406
5322 116 50484	4,64K	1	MR25 R1407
5322 116 54516	365	1	MR25 R1408
5322 116 50731	10,5K	1	MR25 R1409
5322 116 50729	4,22K	1	MR25 R1411
5322 116 54446	56,2	1	MR25 R1412
5322 116 54012	6,81K	1	MR25 R1413
5322 116 54567	1,69K	1	MR25 R1414
5322 116 50479	15,4K	1	MR25 R1416
5322 116 50524	3,01K	1	MR25 R1417
5322 116 54482	133	1	MR25 R1418
5322 100 10112	1K	20	0,5W R1419
5322 100 10144	2,2K	20	0.75W R1420
5322 116 54541	825	1	MR25 R1421
5322 116 54541	825	1	MR25 R1422
5322 116 54525	511	1	MR25 R1423
5322 116 54525	511	1	MR25 R1424
5322 116 54529	619	1	MR25 R1425
5322 116 50664	2,05K	1	MR25 R1426
5322 116 50664	2,05K	1	MR25 R1427
5322 116 50664	2,05K	1	MR25 R1428
5322 116 50579	3,16K	1	MR25 R1429
5322 100 10133	220	20	0.75W R1430
5322 116 54619	10K	1	MR25 R1431
5322 116 54619	10K	1	MR25 R1432
5322 116 50728	1,87K	1	MR25 R1433
5322 116 54619	10K	1	MR25 R1434
5322 116 54474	110	1	MR25 R1435
5322 116 50636	2,74K	1	MR25 R1436
5322 116 50572	12,1K	1	MR25 R1437
5322 116 54554	1,1K	1	MR25 R1438
5322 116 54637	17,8K	1	MR25 R1439
5322 111 30396	22	5	CR16 R1442
5322 100 10143	1K	20	0.75W R1444
5322 116 50457	215	1	MR25 R1445
5322 116 54506	287	1	MR25 R1446
5322 116 50635	1,47K	1	MR25 R1447
5322 116 54635	16,9K	1	MR25 R1448
5322 116 54643	20,5K	1	MR25 R1449
5322 116 54515	348	1	MR25 R1451
5322 116 50579	3,16K	1	MR25 R1452
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5322 116 54506	287	1	MR25 R1456
5322 116 54619	10K	1	MR25 R1457
5322 116 54565	1,62K	1	MR25 R1458
5322 116 54615	9,09K	1	MR25 R1459
5322 116 50579	3,16K	1	MR25 R1461
5322 100 10141	10K	20	0.75W R1462
5322 116 54648	24,9K	1	MR25 R1463
5322 116 54619	10K	1	MR25 R1466
5322 111 30396	22	5	CR16 R1467
5322 116 50509	4,87K	1	MR25 R1468
5322 116 54519	402	1	MR25 R1470
5322 116 54529	619	1	MR25 R1471
5322 116 54576	2,37K	1	MR25 R1472
5322 116 50524	3,01K	1	MR25 R1473
5322 111 30356	43	5	CR16 R1474
5322 116 54442	51,1	1	MR25 R1476
5322 116 50572	12,1K	1	MR25 R1477
5322 116 50524	3,01K	1	MR25 R1478
5322 116 54571	1,96K	1	MR25 R1480
5322 116 54508	301	1	MR25 R1481
5322 116 50636	2,74K	1	MR25 R1482
5322 116 50572	12,1K	1	MR25 R1483
5322 116 50524	3,01K	1	MR25 R1484
5322 116 54508	301	1	MR25 R1486
5322 116 54565	1,62K	1	MR25 R1487
5322 116 54011	5,62K	1	MR25 R1488
5322 111 30356	43	5	CR16 R1489
5322 116 50583	5,9K	1	MR25 R1490
5322 116 50524	3,01K	1	MR25 R1491
4822 111 30324	100	5	CR16 R1493
5322 116 54442	51,1	1	MR25 R1494
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5322 116 54508	301	1	MR25 R1496
5322 116 50636	2,74K	1	MR25 R1497
5322 100 10114	4,7K	20	0.5W R1498
5322 116 50636	2,74K	1	MR25 R1499
5322 116 50559	27,4K	1	MR25 R1501
5322 116 50583	5,9K	1	MR25 R1502
5322 101 14069	22K	20	0.5W R1513
5322 101 14069	22K	20	0.5W R1514
5322 116 54005	3,32K	1	MR25 R1600
5322 116 50491	22,6	1	MR25 R1601
5322 116 50608	6,19K	1	MR25 R1602
5322 116 50636	2,74K	1	MR25 R1603
5322 116 54519	402	1	MR25 R1604
5322 116 54466	90,9	1	MR25 R1605
5322 116 54466	90,9	1	MR25 R1606
5322 116 54489	169	1	MR25 R1607
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5322 116 50636	2,74K	1	MR25 R1613
5322 116 50636	2,74K	1	MR25 R1614
5322 116 54619	10K	1	MR25 R1617
5322 116 54696	100K	1	MR25 R1701
4822 111 30245	47	5	CR16 R1702
5322 116 54009	562	1	MR25 R1703
5322 116 50479	15,4K	1	MR25 R1704
5322 116 50558	18,7K	1	MR25 R1705
5322 111 30396	22	5	CR16 R1706
5322 116 50479	15,4K	1	MR25 R1707
5322 111 30396	22	5	CR16 R1708
5322 116 54549	1K	1	MR25 R1709
4822 110 63174	330K	5	CR25 R1711
5322 111 30356	43	5	CR16 R1712
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5322 116 50509	4,87K	1	MR25 R1717
5322 116 54587	3,65K	1	MR25 R1718
5322 116 50572	12,1K	1	MR25 R1719
5322 111 30396	22	5	CR16 R1721
5322 116 50479	15,4K	1	MR25 R1722
5322 116 54549	1K	1	MR25 R1723
4822 110 63165	150K	5	CR25 R1724
5322 116 50479	15,4K	1	MR25 R1726
5322 111 30396	22	5	CR16 R1727
5322 116 54696	100K	1	MR25 R1728
4822 111 30245	47	5	CR16 R1729
5322 116 50558	18,7K	1	MR25 R1730
5322 116 54009	562	1	MR25 R1731
4822 110 63036	2,2	5	CR25 R1732
4822 110 63036	2,2	5	CR25 R1733
5322 116 54743	301K	1	MR25 R1803
5322 116 54743	301K	1	MR25 R1804
5322 116 55149	24,9K	1	MR30 R1805
4822 110 63214	10M	10	CR25 R1806
4822 110 63196	2,2M	10	CR25 R1807
5322 116 54426	121	1	MR25 R1808
5322 116 54549	1K	1	MR25 R1809
5322 116 50557	46,4K	1	MR25 R1810
4822 112 21054	10	5	4.2W R1811
5322 116 54549	1K	1	MR25 R1812
5322 116 50664	2,05K	1	MR25 R1813
5322 111 44195	10	5	0.5W R1814

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5322 116 50442	48,7K	1	MR25 R1817
5322 116 54965	82	5	PR52 R1818
5322 116 54619	10K	1	MR25 R1819
5322 116 54549	1K	1	MR25 R1820
5322 116 54549	1K	1	MR25 R1821
5322 116 50731	10,5K	1	MR25 R1822
5322 116 54529	619	1	MR25 R1823
5322 116 54549	1K	1	MR25 R1824
5322 116 54469	100	1	MR25 R1825
5322 116 54574	2,21K	1	MR25 R1826
5322 116 54558	8,25K	1	MR25 R1827
5322 100 10115	1K	20	0,5W R1828
5322 116 50586	1,54K	1	MR25 R1829
5322 116 50669	205	1	MR25 R1830
5322 116 54558	8,25K	1	MR25 R1831
5322 116 50664	2,05K	1	MR25 R1832
5322 116 54906	75	1	MR30 R1833
5322 116 54619	10K	1	MR25 R1834
5322 116 54014	23,7	1	MR25 R1835
5322 116 50559	27,4K	1	MR25 R1836
5322 116 54696	100K	1	MR25 R1837
4822 110 63187	1M	5	CR25 R1838
5322 116 54648	24,9K	1	MR25 R1839
5322 116 54192	5,1	5	CR25 R1840
5322 116 54469	100	1	MR25 R1841
5322 116 54469	100	1	MR25 R1842
5322 116 54738	274K	1	MR25 R1843
5322 116 54619	10K	1	MR25 R1844
4822 110 63058	15	5	CR25 R1845
5322 116 54696	100K	1	MR25 R1846
5322 116 54696	100K	1	MR25 R1847
5322 116 54525	511	1	MR25 R1848
5322 116 55012	47	5	PR52 R1849
5322 116 34039	22	20	0.5W R1851
5322 116 54069	12,1	1	MR25 R1852
5322 116 54069	12,1	1	MR25 R1853
5322 116 54696	100K	1	MR25 R1857
5322 116 50904	30,1	1	MR25 R1858
5322 116 54469	100	1	MR25 R1901
5322 116 54641	19,6K	1	MR25 R1902
5322 116 50608	6,19K	1	MR25 R1903
5322 116 54525	511	1	MR25 R1904
5322 100 10114	4,7K	20	0.5W R1906
5322 116 54538	787	1	MR25 R1907
5322 116 50415	1,15K	1	MR25 R1908
5322 116 50608	6,19K	1	MR25 R1909
5322 116 54524	499	1	MR25 R1911
5322 116 54469	100	1	MR25 R1912
5322 116 54497	226	1	MR25 R2001
4822 110 42187	1M	5	VR37 R2002
4822 110 42189	1,2M	5	VR37 R2003
5322 116 54619	10K	1	MR25 R2004
5322 116 54565	1,62K	1	MR25 R2006
5322 116 54469	100	1	MR25 R2007
5322 116 50592	442	1	MR25 R2008
5322 116 54462	82,5	1	MR25 R2009
5322 116 54657	31,6K	1	MR25 R2010
5322 116 54543	866	1	MR25 R2011
5322 116 54683	68,1K	1	MR25 R2012
5322 116 50636	2,74K	1	MR25 R2013
4822 110 63178	470K	5	CR25 R2016
4822 110 42214	10M	5	VR37 R2024
5322 116 54009	562	1	MR25 R2102
5322 116 54009	562	1	MR25 R2103
5322 116 54009	562	1	MR25 R2104
5322 116 54009	562	1	MR25 R2106
5322 116 54009	562	1	MR25 R2107
5322 116 54009	562	1	MR25 R2108
5322 116 54009	562	1	MR25 R2109
5322 116 54009	562	1	MR25 R2111
5322 116 54469	100	1	MR25 R2112

SERV. CODE	DESCR		POS
5322 116 54619	10K	1	MR25 R2201
5322 116 54619	10K	1	MR25 R2202
5322 116 54576	2,37K	1	MR25 R2203
5322 116 50483	38,3K	1	MR25 R2204
5322 116 50581	2,49K	1	MR25 R2206
5322 116 50483	38,3K	1	MR25 R2207
5322 116 54576	2,37K	1	MR25 R2208
5322 116 50558	18,7K	1	MR25 R2209
5322 101 14008	2,2K	20	0.5W R2211
5322 116 54557	1,21K	1	MR25 R2212
5322 116 50442	48,7K	1	MR25 R2213
5322 100 10113	10K	20	0,5W R2214
5322 116 50442	48,7K	1	MR25 R2216
5322 116 54557	1,21K	1	MR25 R2217
5322 116 54557	1,21K	1	MR25 R2219
5322 116 54557	1,21K	1	MR25 R2221
5322 116 50593	16,2K	1	MR25 R2222
5322 116 54704	121K	1	MR25 R2223
5322 100 10114	4,7K	20	0.5W R2224
5322 116 50729	4,22K	1	MR25 R2226
5322 116 54686	75K	1	MR25 R2227
5322 116 54643	20,5K	1	MR25 R2228
4822 110 63187	1M	5	CR25 R2229
5322 116 54696	100K	1	MR25 R2230
5322 116 54011	5,62K	1	MR25 R2231
5322 116 54683	68,1K	1	MR25 R2232
5322 116 50729	4,22K	1	MR25 R2233
5322 116 50508	487	1	MR25 R2234
5322 116 50593	16,2K	1	MR25 R2236
5322 116 50593	16,2K	1	MR25 R2237
5322 116 50593	16,2K	1	MR25 R2238
5322 116 54648	24,9K	1	MR25 R2301
5322 116 54648	24,9K	1	MR25 R2302
5322 116 54648	24,9K	1	MR25 R2303
5322 116 54648	24,9K	1	MR25 R2304
5322 116 50926	40,2	1	MR25 R2401
5322 116 50926	40,2	1	MR25 R2402
5322 116 54476	115	1	MR25 R2403
5322 116 50459	422	1	MR25 R2404
5322 116 54508	301	1	MR25 R2405
5322 116 54545	909	1	MR25 R2406
5322 116 54545	909	1	MR25 R2407
5322 116 54545	909	1	MR25 R2408
5322 116 54545	909	1	MR25 R2409
5322 116 54571	1,96K	1	MR25 R2411
5322 116 54545	909	1	MR25 R2412
5322 116 54446	56,2	1	MR25 R2413
5322 116 54545	909	1	MR25 R2414
5322 116 54641	19,6K	1	MR25 R2415
5322 116 50664	2,05K	1	MR25 R2416
5322 116 54335	750K	1	MR30 R2501
5322 116 54549	1K	1	MR25 R2502
5322 116 54549	1K	1	MR25 R2503
5322 116 54742	294K	1	MR25 R2504
4822 111 30333	1M	10	CR16 R2508
5322 116 54442	51,1	1	MR25 R2509
5322 116 54655	30,1K	1	MR25 R2511
5322 116 50621	536	1	MR25 R2512
5322 116 50672	51,1K	1	MR25 R2513
5322 116 54549	1K	1	MR25 R2514
5322 116 51052	42,2	1	MR25 R2516
5322 116 54549	1K	1	MR25 R2517
4822 111 30325	150	5	CR16 R9037
4822 111 30325	150	5	CR16 R9038
5322 116 50664	2,05K	1	MR25 R9039
5322 116 54694	90,9K	1	MR25 R9041
5322 116 54694	90,9K	1	MR25 R9042
4822 111 30122	3,6K	5	CR16 R9043
4822 111 30122	3,6K	5	CR16 R9044
5322 116 54606	7,15K	1	MR25 R9048
5322 116 50635	1,47K	1	MR25 R9049
4822 116 30087	1,5K	10	0.5W R9051

DIODES

PRM SERV. CODE	TYPE		POS
5322 130 34595	CQY24A-I		GR1
5322 130 34595	CQY24A-I		GR2
5322 130 34603	5082-7433	HP	GR3
5322 130 34603	5082-7433	HP	GR4
5322 130 34595	CQY24A-I		GR5
5322 130 34037	BAV45		GR101
5322 130 30283	AAZ17		GR102
4822 130 30613	BAW62		GR301
4822 130 34049	BZX75-C2V1		GR302
5322 130 30644	BA182		GR303
5322 130 30644	BA182		GR304
4822 130 30861	BZX79-C7V5		GR311
4822 130 30613	BAW62		GR351
4822 130 34049	BZX75-C2V1		GR352
5322 130 30644	BA182		GR353
5322 130 30644	BA182		GR354
4822 130 34233	BZX79-B5V1		GR356
4822 130 34233	BZX79-B5V1		GR357
4822 130 34049	BZX75-C2V1		GR401
4822 130 34174	BZX79-C4V7		GR402
4822 130 30613	BAW62		GR403
4822 130 34278	BZX79-C6V8		GR404
4822 130 30613	BAW62		GR406
5322 130 34511	SELECTED		GR407
4822 130 30613	BAW62		GR408
4822 130 30613	BAW62		GR409
4822 130 34173	BZX79-C5V6		GR502
5322 130 34233	BZX79-C5V1		GR503
4822 130 30613	BAW62		GR505
4822 130 30613	BAW62		GR506
4822 130 34173	BZX79-C5V6		GR507
5322 130 30605	BAX17		GR508
5322 130 30605	BAX17		GR509
5322 130 30605	BAX17		GR510
5322 130 30605	BAX17		GR511
5322 130 30605	BAX17		GR512
4822 130 34383	BZX79-C47		GR513
5322 130 30605	BAX17		GR514
5322 130 30605	BAX17		GR515
5322 130 30605	BAX17		GR516
5322 130 30605	BAX17		GR517
5322 130 30605	BAX17		GR518
5322 130 34605	BAX12		GR519
4822 130 34167	BZX79-C6V2		GR521
5322 130 34605	BAX12		GR522
5322 130 34337	BAV99		GR600
5322 130 34337	BAV99		GR601
5322 130 34331	BAV70		GR602
4822 130 30613	BAW62		GR603
4822 130 30613	BAW62		GR604
4822 130 30765	BZX75-C3V6		GR606
4822 130 30613	BAW62		GR608
4822 130 30613	BAW62		GR609
4822 130 30613	BAW62		GR801
4822 130 30613	BAW62		GR802
4822 130 30613	BAW62		GR803
4822 130 30613	BAW62		GR804
4822 130 30613	BAW62		GR807
4822 130 30613	BAW62		GR808
4822 130 30613	BAW62		GR809
5322 130 34337	BAV99		GR1000
5322 130 34337	BAV99		GR1001
5322 130 34331	BAV70		GR1002
4822 130 30613	BAW62		GR1003
4822 130 30613	BAW62		GR1004
4822 130 30765	BZX75-C3V6		GR1006
4822 130 30613	BAW62		GR1201
4822 130 30613	BAW62		GR1202
4822 130 30613	BAW62		GR1203
4822 130 30613	BAW62		GR1204

PRM SERV. CODE	TYPE	POS
4822 130 30613	BAW62	GR1206
4822 130 30613	BAW62	GR1207
4822 130 30613	BAW62	GR1401
4822 130 30613	BAW62	GR1402
4822 130 30613	BAW62	GR1403
4822 130 30613	BAW62	GR1404
4822 130 30613	BAW62	GR1406
4822 130 30613	BAW62	GR1407
4822 130 30613	BAW62	GR1408
5322 130 34605	BAX12	GR1601
5322 130 34233	BZX79-C5V1	GR1701
4822 130 34328	BZX79-B30	GR1702
4822 130 34173	BZX79-B5V6	GR1703
4822 130 34145	BZX79-B39	GR1704
4822 130 34329	BZX79-B43	GR1706
5322 130 34233	BZX79-C5V1	GR1707
4822 130 30817	BYX55-600	GR1801
4822 130 30817	BYX55-600	GR1802
4822 130 30817	BYX55-600	GR1803
4822 130 30817	BYX55-600	GR1804
4822 130 30839	BY206	GR1806
4822 130 30839	BY206	GR1807
4822 130 20039	BR100-03	GR1809
5322 130 34605	BAX12	GR1810
4822 130 30817	BYX55-600	GR1811
5322 130 34297	BZX79-C10	GR1812
5322 130 34034	BZX61-C75	GR1813
5322 130 30565	BZX61-C47	GR1814
5322 130 34233	BZX79-C5V1	GR1815
4822 130 30817	BYX55-600	GR1816
4822 130 30613	BAW62	GR1818
4822 130 34048	BZX75-C2V8	GR1819
4822 130 30613	BAW62	GR1820
4822 130 30839	BY206	GR1821
4822 130 30839	BY206	GR1822
4822 130 30613	BAW62	GR1823
4822 130 30839	BY206	GR1824
5322 130 34605	BAX12	GR1825
4822 130 30839	BY206	GR1826
4822 130 30839	BY206	GR1827
4822 130 30613	BAW62	GR1828
4822 130 30839	BY206	GR1831
4822 130 30839	BY206	GR1832
4822 130 30839	BY206	GR1833
4822 130 30839	BY206	GR1834
4822 130 30839	BY206	GR1836
4822 130 30839	BY206	GR1837
4822 130 30839	BY206	GR1838
4822 130 30839	BY206	GR1839
4822 130 30839	BY206	GR1841
4822 130 30839	BY206	GR1842
4822 130 30839	BY206	GR1843
4822 130 30839	BY206	GR1844
4822 130 30839	BY206	GR1846
4822 130 30817	BYX55-600	GR1847
4822 130 30839	BY206	GR1848
4822 130 30839	BY206	GR1849
4822 130 30817	BYX55-600	GR1851
4822 130 34173	BZX79-C5V6	GR1901
5322 130 34594	BY409	GR2001
5322 130 34605	BAX12	GR2002
4822 130 30839	BY206	GR2003
4822 130 30613	BAW62	GR2004
5322 130 34605	BAX12	GR2005
5322 130 34594	BY409	GR2013
5322 130 34594	BY409	GR2014
5322 130 34594	BY409	GR2016
5322 130 34594	BY409	GR2017
5322 130 34594	BY409	GR2018
5322 130 34594	BY409	GR2019
5322 130 34594	BY409	GR2021
5322 130 34594	BY409	GR2022

SERV. CODE	TYPE	POS
5322 130 34594	BY409	GR2023
4822 130 30613	BAW62	GR2102
4822 130 30613	BAW62	GR2201
4822 130 30613	BAW62	GR2202
4822 130 30613	BAW62	GR2203
4822 130 30613	BAW62	GR2204
4822 130 30613	BAW62	GR2301
4822 130 41119	BY126	GR2401
4822 130 30613	BAW62	GR2402
4822 130 30613	BAW62	GR2403
4822 130 30613	BAW62	GR2404
4822 130 30613	BAW62	GR2406
4822 130 30613	BAW62	GR9031
4822 130 30613	BAW62	GR9032

TRANSISTORS

SERV. CODE	TYPE	POS
5322 130 44605	ON471	TS101
5322 130 44459	BFT25R	TS102
5322 130 44606	BFR92R	TS103
4822 130 40941	BC558	TS200
4822 130 40938	BC548	TS205
4822 130 40941	BC558	TS301
4822 130 40941	BC558	TS302
4822 130 40941	BC558	TS303
4822 130 40938	BC548	TS304
4822 130 40938	BC548	TS306
4822 130 40938	BC548	TS311
4822 130 40941	BC558	TS351
4822 130 40941	BC558	TS352
4822 130 40941	BC558	TS353
4822 130 40938	BC548	TS354
4822 130 40938	BC548	TS356
5322 130 44618	BFR94R	TS401
5322 130 44618	BFR94R	TS402
4822 130 40938	BC548	TS503
5322 130 44396	BF324	TS504
5322 130 40672	BFW44	TS506
4822 130 40908	BF336	TS507
4822 130 40908	BF336	TS508
5322 130 40493	BFY90	TS509
4822 130 40941	BC558	TS511
4822 130 40968	BSS38	TS512
4822 130 40941	BC558	TS513
4822 130 40968	BSS38	TS514
4822 130 40938	BC548	TS516
4822 130 40968	BSS38	TS518
4822 130 40941	BC558	TS519
4822 130 40938	BC548	TS521
4822 130 40941	BC558	TS522
4822 130 40938	BC548	TS523
4822 130 40941	BC558	TS524
4822 130 40938	BC548	TS526
4822 130 40645	BD135	TS527
4822 130 40712	BD136	TS528
5322 130 44361	ON475	TS601
5322 130 44337	BCW33	TS602
5322 130 44338	BFS17R	TS603
5322 130 44662	SELECTED	TS604
5322 130 44338	BFS17R	TS607
5322 130 44663	SELECTED	TS608
5322 130 44342	BCW33R	TS609
5322 130 44338	BFS17R	TS611
5322 130 44342	BCW33R	TS612
5322 130 40781	BFS17	TS613
5322 130 40781	BFS17	TS614
5322 130 44342	BCW33R	TS616
5322 130 44338	BFS17R	TS617
5322 130 40781	BFS17	TS618
5322 130 44337	BCW33	TS623
5322 130 44342	BCW33R	TS624
5322 130 44337	BCW33	TS626
5322 130 44338	BFS17R	TS627

SERV. CODE	TYPE	POS
5322 130 44743	BSR12	TS628
5322 130 44743	BSR12	TS629
5322 130 44778	BSR12-R	TS631
5322 130 44778	BSR12-R	TS632
5322 130 40781	BFS17	TS633
5322 130 44337	BCW33	TS634
5322 130 44337	BCW33	TS636
5322 130 44743	BSR12	TS637
5322 130 44743	BSR12	TS638
5322 130 44778	BSR12-R	TS639
5322 130 44342	BCW33R	TS641
5322 130 44342	BCW33R	TS642
5322 130 44338	BFS17R	TS643
5322 130 44662	SELECTED	TS644
5322 130 40781	BFS17	TS646
5322 130 44663	SELECTED	TS647
5322 130 44356	537BSY-R	TS648
5322 130 44338	BFS17R	TS649
5322 130 40493	BFY90	TS800
5322 130 40781	BFS17	TS801
5322 130 40781	BFS17	TS802
5322 130 40781	BFS17	TS803
5322 130 40781	BFS17	TS804
5322 130 44342	BCW33R	TS805
5322 130 44335	BCW30	TS806
5322 130 44336	BSV52	TS807
5322 130 44336	BSV52	TS808
5322 130 44342	BCW33R	TS809
5322 130 44337	BCW33	TS811
5322 130 44342	BCW33R	TS812
5322 130 44342	BCW33R	TS813
5322 130 44338	BFS17R	TS814
5322 130 44339	BFS19R	TS815
5322 130 44359	537BSY	TS816
5322 130 44359	537BSY	TS817
5322 130 44356	537BSY-R	TS818
5322 130 44339	BFS19R	TS819
5322 130 44339	BFS19R	TS820
5322 130 44339	BFS19R	TS821
5322 130 44339	BFS19R	TS822
5322 130 44339	BFS19R	TS823
5322 130 44342	BCW33R	TS824
5322 130 44337	BCW33	TS825
5322 130 44337	BCW33	TS826
5322 130 30187	BCY88	TS827
5322 130 44342	BCW33R	TS829
5322 130 44342	BCW33R	TS831
5322 130 44361	ON475	TS1001
5322 130 40781	BFS17	TS1003
5322 130 44338	BFS17R	TS1004
5322 130 40781	BFS17	TS1007
5322 130 40781	BFS17	TS1008
5322 130 40781	BFS17	TS1011
5322 130 44337	BCW33	TS1012
5322 130 44338	BFS17R	TS1013
5322 130 44338	BFS17R	TS1014
5322 130 44337	BCW33	TS1016
5322 130 40781	BFS17	TS1017
5322 130 44338	BFS17R	TS1018
5322 130 44338	BFS17R	TS1027
5322 130 44778	BSR12-R	TS1028
5322 130 44743	BSR12	TS1029
5322 130 44778	BSR12-R	TS1031
5322 130 44778	BSR12-R	TS1032
5322 130 40781	BFS17	TS1033
5322 130 44337	BCW33	TS1034
5322 130 44342	BCW33R	TS1036
5322 130 44743	BSR12	TS1037
5322 130 44743	BSR12	TS1038
5322 130 44778	BSR12-R	TS1039
5322 130 44342	BCW33R	TS1041
5322 130 44342	BCW33R	TS1042

SERV. CODE	TYPE	POS
5322 130 44338	BFS17R	TS1043
5322 130 40781	BFS17	TS1044
5322 130 44396	BF324	TS1045
5322 130 40781	BFS17	TS1046
5322 130 44338	BFS17R	TS1047
5322 130 40781	BFS17	TS1201
5322 130 40781	BFS17	TS1202
5322 130 40781	BFS17	TS1203
5322 130 40781	BFS17	TS1204
5322 130 44335	BCW30	TS1206
5322 130 44336	BSV52	TS1207
5322 130 44336	BSV52	TS1208
5322 130 44337	BCW33	TS1209
5322 130 44339	BFS19R	TS1210
5322 130 44342	BCW33R	TS1211
5322 130 44339	BFS19R	TS1212
5322 130 44339	BFS19R	TS1213
5322 130 44337	BCW33	TS1214
5322 130 44337	BCW33	TS1216
5322 130 40781	BFS17	TS1217
5322 130 44359	537BSY	TS1218
5322 130 44359	537BSY	TS1219
5322 130 44359	537BSY	TS1221
5322 130 44356	537BSY-R	TS1222
5322 130 44356	537BSY-R	TS1223
5322 130 44342	BCW33R	TS1224
5322 130 30187	BCY88	TS1226
5322 130 44337	BCW33	TS1227
4822 130 44197	BC558B	TS1400
4822 130 44197	BC558B	TS1401
4822 130 40938	BC548	TS1402
5322 130 44093	BSV78	TS1403
5322 130 44337	BCW33	TS1404
4822 130 40938	BC548	TS1405
5322 130 44337	BCW33	TS1406
5322 130 44342	BCW33R	TS1407
5322 130 44337	BCW33	TS1408
5322 130 44337	BCW33	TS1409
5322 130 44743	BSR12	TS1411
5322 130 44337	BCW33	TS1412
5322 130 44342	BCW33R	TS1413
5322 130 44337	BCW33	TS1414
5322 130 44337	BCW33	TS1416
5322 130 44342	BCW33R	TS1417
5322 130 44337	BCW33	TS1418
5322 130 44743	BSR12	TS1419
5322 130 44743	BSR12	TS1421
5322 130 44743	BSR12	TS1422
5322 130 44799	BCX18	TS1423
5322 130 44799	BCX18	TS1424
5322 130 44743	BSR12	TS1426
5322 130 40417	BSX20	TS1601
5322 130 40417	BSX20	TS1602
4822 130 40941	BC558	TS1603
5322 130 40417	BSX20	TS1604
5322 130 40672	BFW44	TS1701
4822 130 40908	BF336	TS1702
5322 130 40417	BSX20	TS1703
5322 130 44396	BF324	TS1704
5322 130 44396	BF324	TS1706
5322 130 44127	2N2894A	TS1707
5322 130 40672	BFW44	TS1708
4822 130 40908	BF336	TS1709
5322 130 44457	BDY93-01	TS1801
5322 130 24009	BTX18-500	TS1802
5322 130 44406		TS1803
5322 130 44019	BSX60	TS1806
4822 130 44246	BC549C	TS1807
5322 130 40482	BRY39	TS1808
5322 130 44395	CNY43	TS1809
4822 130 40963	BC559	TS1811
4822 130 44246	BC549C	TS1812

SERV. CODE	TYPE		POS
4822 130 44246	BC549C		TS1813
5322 130 44462	BC556A		TS2001
4822 130 40959	BC547B		TS2002
4822 130 44461	BC546B		TS2003
5322 130 44788	BSW68		TS2004
4822 130 44256	BC557		TS2201
4822 130 44256	BC557		TS2202
4822 130 44256	BC557		TS2203
4822 130 44256	BC557		TS2204
4822 130 44257	BC547		TS2206
4822 130 44257	BC547		TS2207
4822 130 44257	BC547		TS2208
4822 130 44257	BC547		TS2209
5322 130 44396	BF324		TS2401
5322 130 40417	BSX20		TS2402
4822 130 44246	BC549C		TS2403
4822 130 44246	BC549C		TS2501
4822 130 44246	BC549C		TS2502
4822 130 44197	BC558B		TS2503

INTEGRATED CIRCUITS

5322 209 85475	LM208T		IC101
5322 111 94032	TF CIRCUIT		IC102
5322 209 84427	TF CIRCUIT		IC301
5322 209 84425	TF CIRCUIT		IC302
5322 209 84342	TBA221		IC303
5322 209 84426	TF CIRCUIT		IC304
5322 209 84428	TF CIRCUIT		IC306
5322 209 84427	TF CIRCUIT		IC351
5322 209 84425	TF CIRCUIT		IC352
5322 209 84342	TBA221		IC353
5322 209 84426	TF CIRCUIT		IC354
5322 209 84483	TF CIRCUIT		IC401
5322 209 84484	TF CIRCUIT		IC402
5322 209 84484	TF CIRCUIT		IC403
5322 209 84485	TF CIRCUIT		IC601
5322 209 84485	TF CIRCUIT		IC1001
5322 209 84528	N7400N	SC	IC1601
5322 209 84512	N7426N	SC	IC1602
5322 209 84166	N7472N	SC	IC1603
5322 209 84899	UA723CK	SC	IC1801
5322 209 84452	TAA521		IC1901
5322 209 84267	N7445N	SC	IC2101
5322 209 85492	N74LS83N	SC	IC2104
5322 209 85486	N74LS04N	SC	IC2106
5322 209 85493	SN74249N-00		IC2107
5322 209 85254	LM741CN		IC2201
5322 209 85486	N74LS04N	SC	IC2301
5322 209 84823	N74LS00N	SC	IC2302
5322 209 84528	N7400N	SC	IC2303
5322 209 85487	SN74L123N-00		IC2304
5322 209 85491	N74LS190N	SC	IC2306
5322 209 85491	N74LS190N	SC	IC2307
5322 209 85491	N74LS190N	SC	IC2308
5322 209 85491	N74LS190N	SC	IC2309
5322 209 84797	SN74L90N-00		IC2312
5322 209 85488	N74LS153N	SC	IC2313
5322 209 85488	N74LS153N	SC	IC2314
5322 209 85489	N74LS157N	SC	IC2316
5322 209 85494	F93S10-PC		IC2401
5322 209 85494	F93S10-PC		IC2402
5322 209 85494	F93S10-PC		IC2403
5322 209 85494	F93S10-PC		IC2404
5322 209 84167	N74S00N	SC	IC2407
5322 209 84167	N74S00N	SC	IC2408
5322 209 84167	N74S00N	SC	IC2409

MISCELLANEOUS

SERV.	CODE	DESCR		POS
5422	131	2902		B 1
5422	130	3473		B 501
5422	130	3473		B 502
5422	167	10014	SAM BUSCONTACT	BU3
5422	167	10004	HF CON BNC	BU4
5422	135	8053	DRAADEIND	BU6
5422	167	10004	HF CON BNC	BU7
5422	167	10004	HF CON BNC	BU8
5422	167	10004	HF CON BNC	BU9
5422	157	4035	SAM SPOEL	L 1
5422	166	1473	SPOEL	L 301
5422	181	6459	COIL	L 301
5422	121	9345	FILTER	L 401
5422	121	9345	FILTER	L 402
5422	121	9345	FILTER	L 403
5422	121	9345	FILTER	L 404
5422	121	9345	FILTER	L 405
5422	121	9345	FILTER	L 406
5422	121	9345	FILTER	L 407
5422	121	9345	FILTER	L 408
5422	121	9345	FILTER	L 409
5422	158	14121	L-K COMBINATIE	L 451
5422	158	14121	L-K COMBINATIE	L 452
5422	159	14213	BAR LOOK COIL	L 501
5422	181	6459	COIL	L 1601
5422	154	14076	SPOEL	L 1602
5422	158	14121	SAM TRAFO	L 1603
5422	158	14121	SAM TRAFO	L 1604
5422	154	14076	SPOEL	L 1605
5422	158	14033	SAMENSPOEL	L 1606
5422	154	14076	SPOEL	L 1607
5422	154	14076	SPOEL	L 1608
5422	154	14076	SPOEL	L 1609
5422	154	14076	SPOEL	L 1610
5422	154	14076	SPOEL	L 1611
5422	154	14076	SPOEL	L 1612
5422	154	14076	SPOEL	L 1613
5422	154	14076	SPOEL	L 1614
5422	154	14076	SPOEL	L 1615
5422	154	14076	SPOEL	L 1616
5422	154	14076	SPOEL	L 1617
5422	154	14076	SPOEL	L 1618
5422	154	14076	SPOEL	L 1619
5422	181	6459	COIL	L 1620
5422	153	13854	MICROSCHAKEL	L 2602
5422	153	13854	MICROSCHAKEL	L 2603
5422	181	6459	COIL	L 2604
5422	154	14076	SPOEL	L 2605
5422	154	14076	SPOEL	L 2606
5422	154	14076	SPOEL	L 2607
5422	154	14076	SPOEL	L 2608
5422	154	14076	SPOEL	L 2609
5422	154	14076	SPOEL	L 2610
5422	154	14076	SPOEL	L 2611
5422	154	14076	SPOEL	L 2612
5422	154	14076	SPOEL	L 2613
5422	154	14076	SPOEL	L 2614
5422	154	14076	SPOEL	L 2615
5422	154	14076	SPOEL	L 2616
5422	154	14076	SPOEL	L 2617
5422	154	14076	SPOEL	L 2618
5422	154	14076	SPOEL	L 2619
5422	181	6459	COIL	L 2620
5422	153	13854	MICROSCHAKEL	L 2621
5422	153	13854	MICROSCHAKEL	L 2622
5422	181	6459	COIL	L 2623
5422	154	14076	SPOEL	L 2624
5422	154	14076	SPOEL	L 2625
5422	154	14076	SPOEL	L

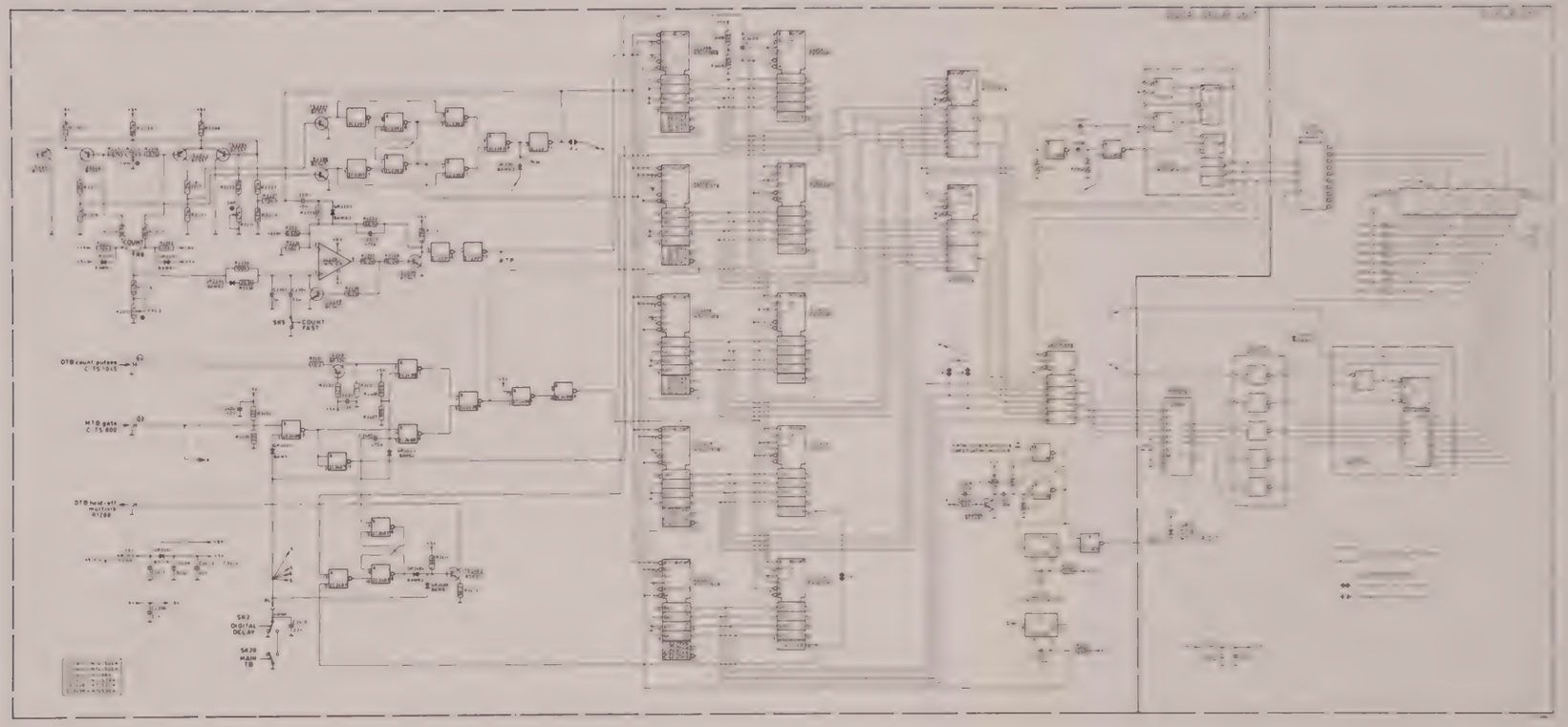


Fig. 3.5. Digital delay circuit diagram

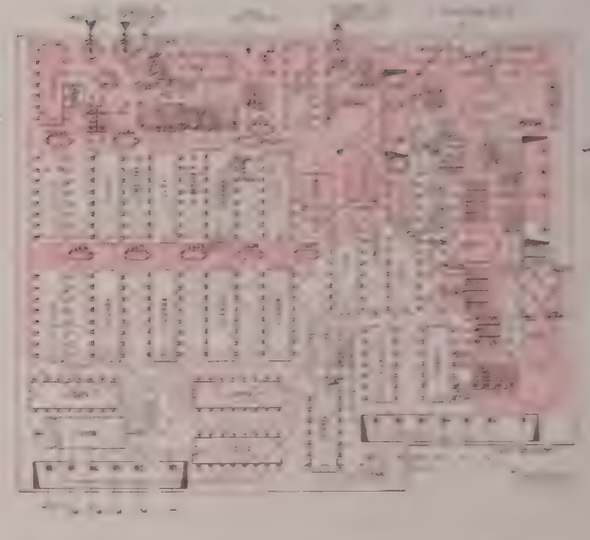


Fig. 3.6. Printed circuit board of the Digital delay unit

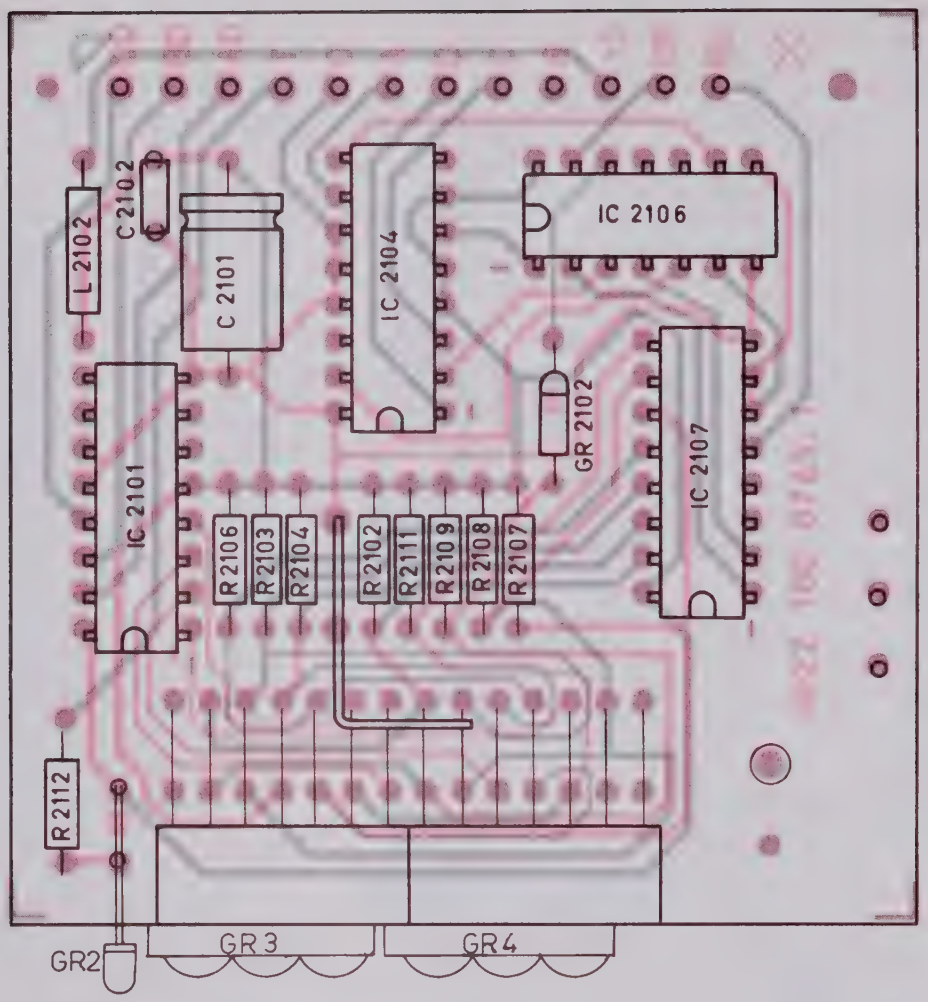
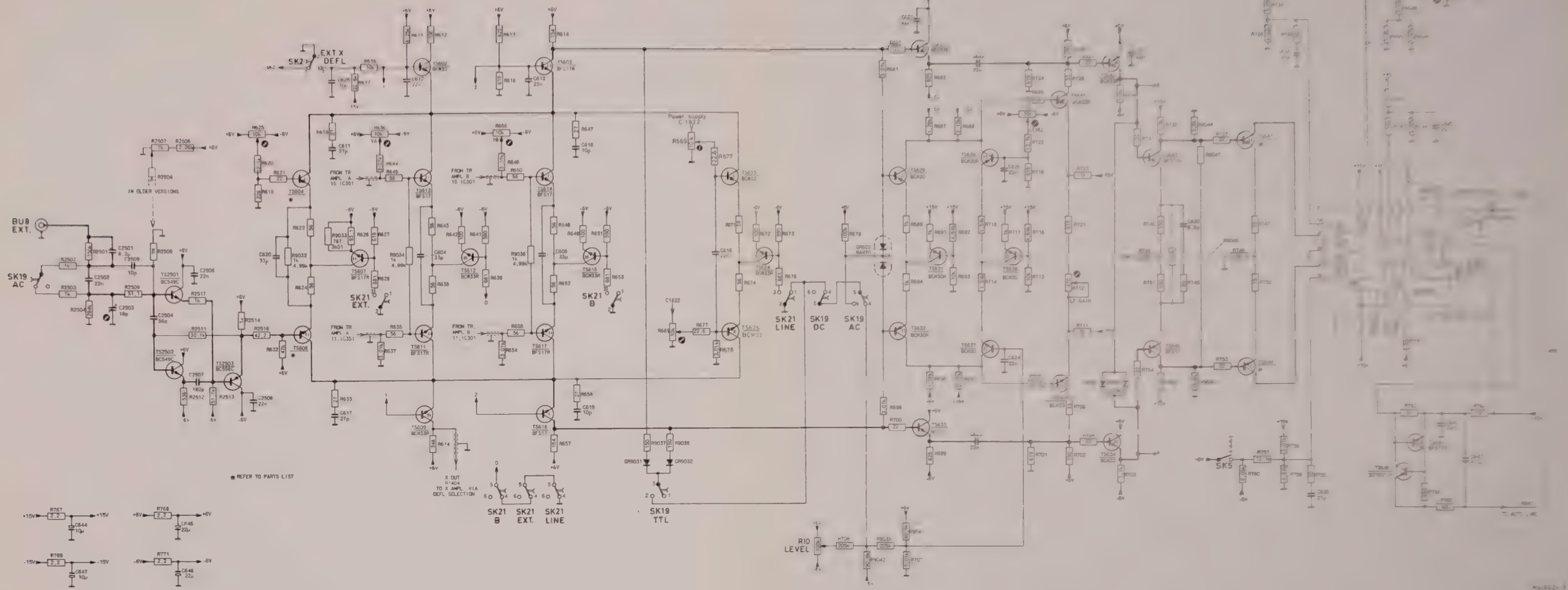


Fig. 3... *inted circuit board of the Digital delay display unit*



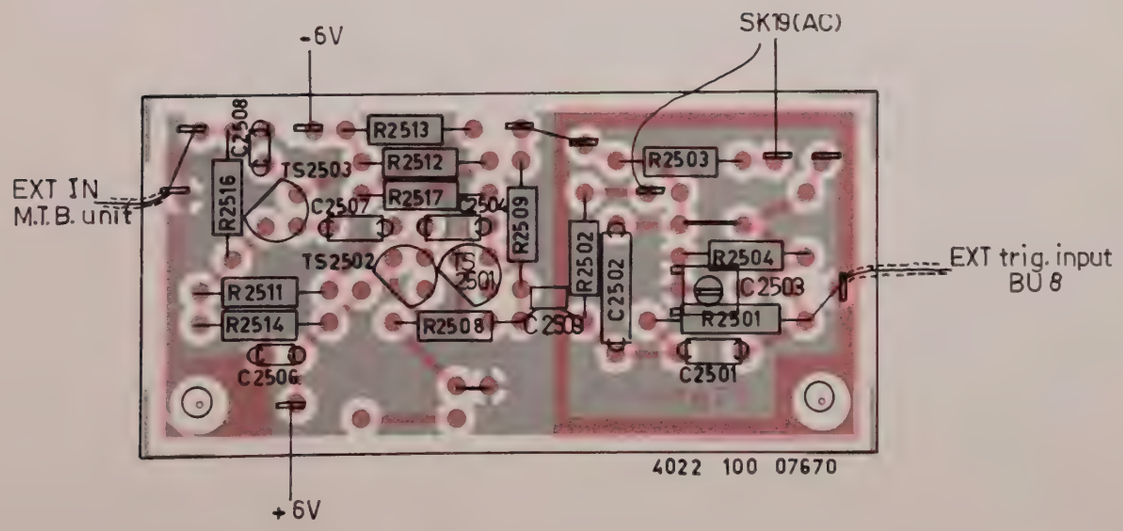


Fig. 3.9. External TTL trigger input circuit board

VHF DUAL TRACE OSCILL. OSCOPE MAIN TRIGGER PM 3226

Fig. 3.8. M.T.B. trigger circuit diagram

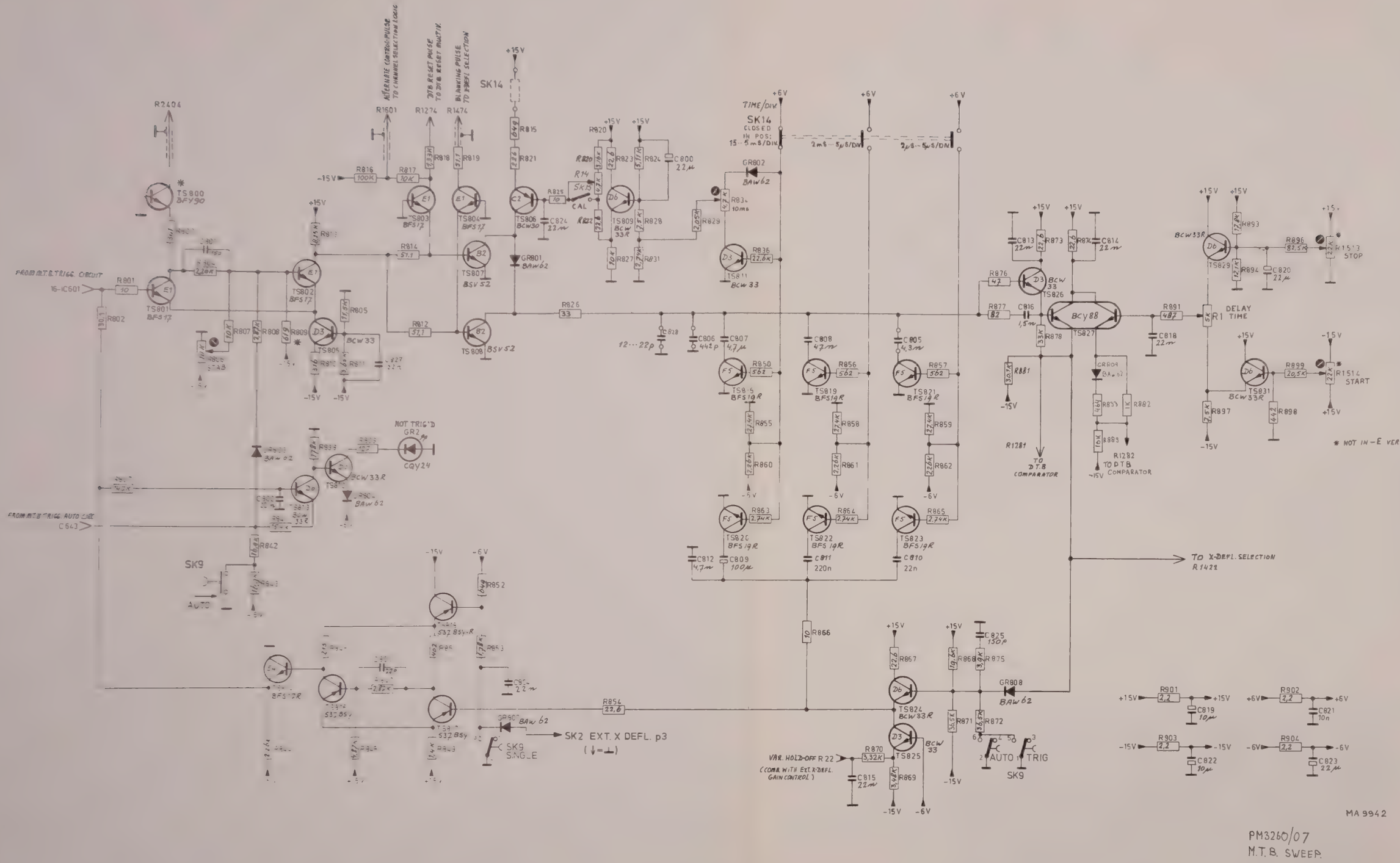


Fig. 3.10. M.T.B. trigger circuit diagram

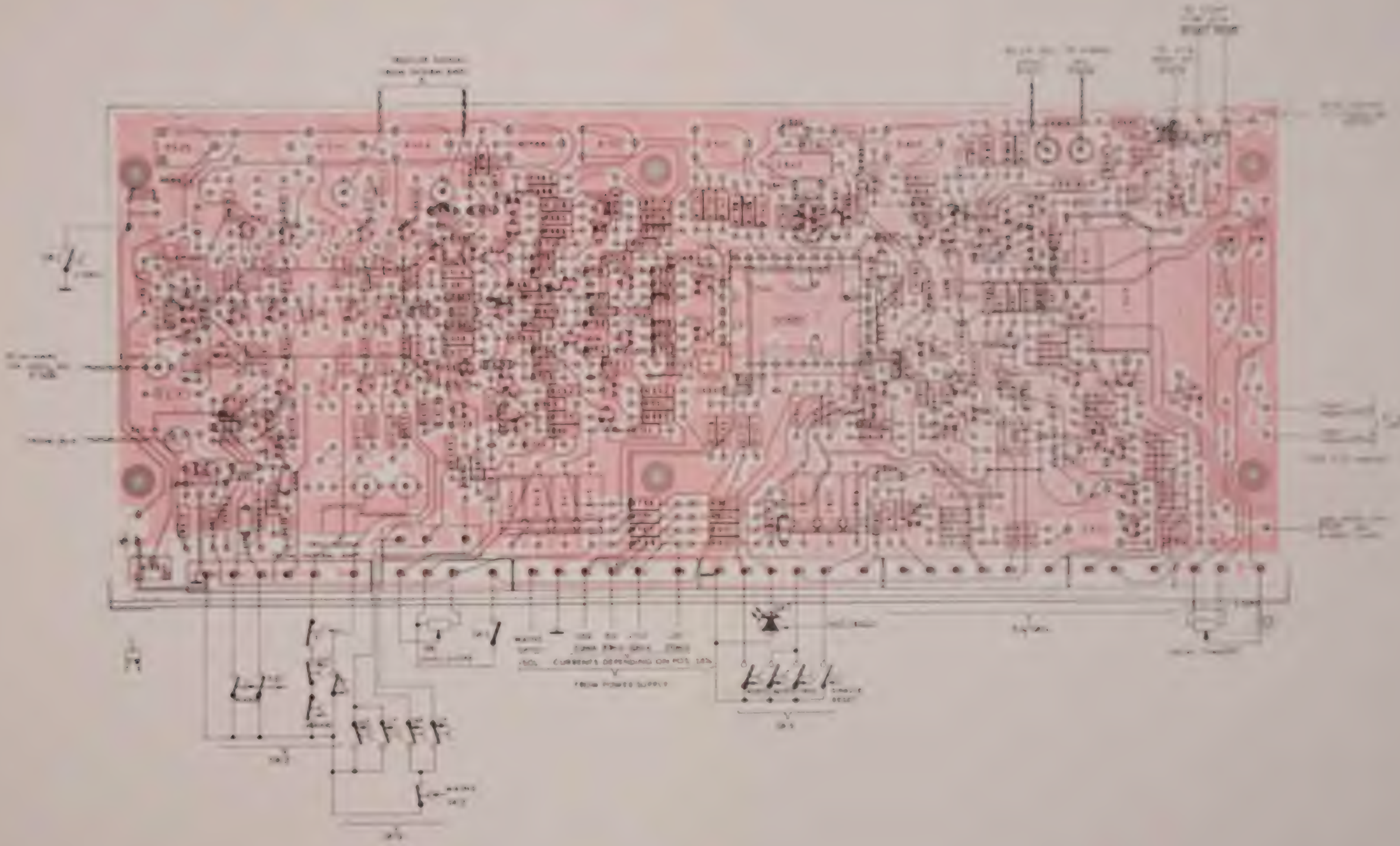


Fig 3.11 M T B control board

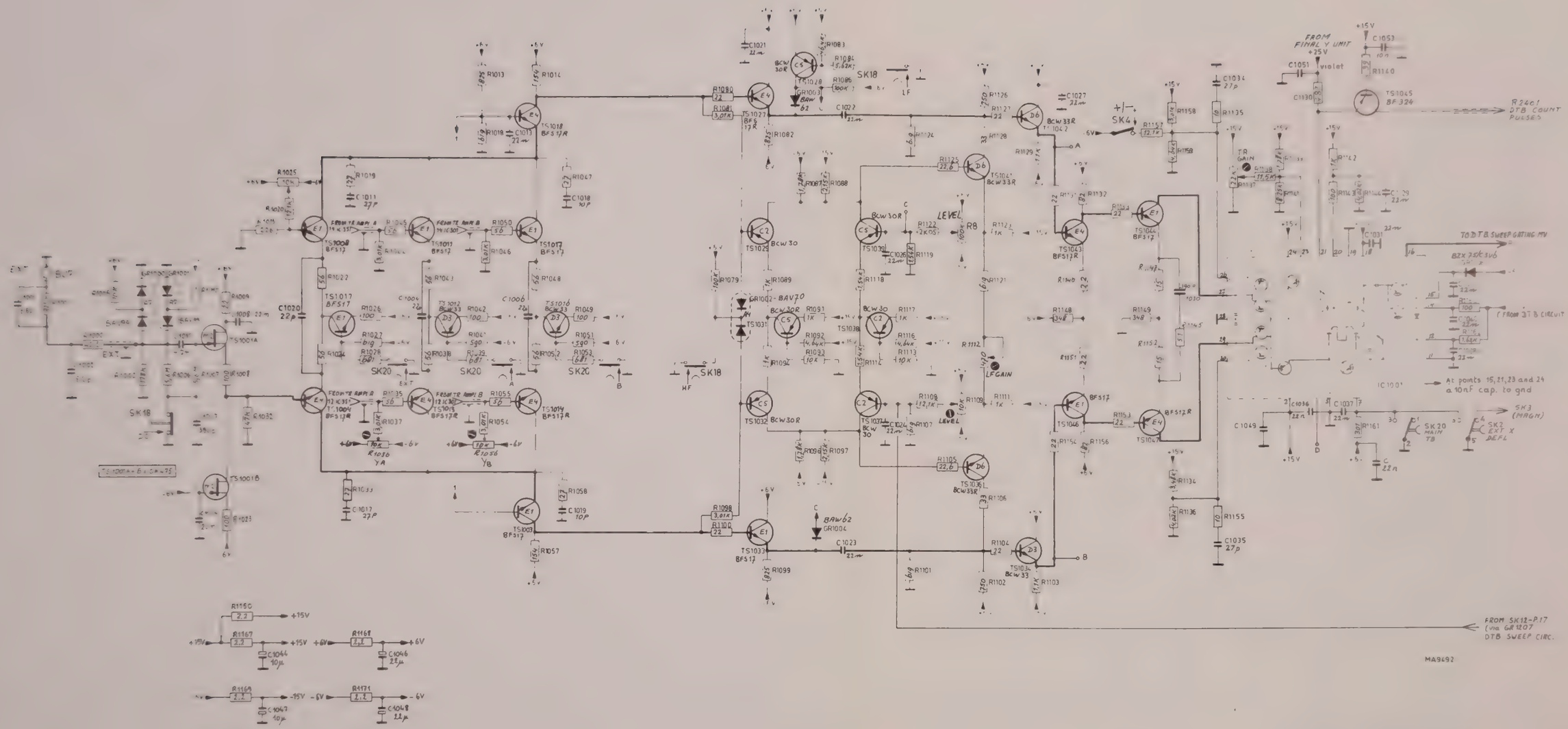


Fig. 3.12. D.T.B. trigger circuit diagram

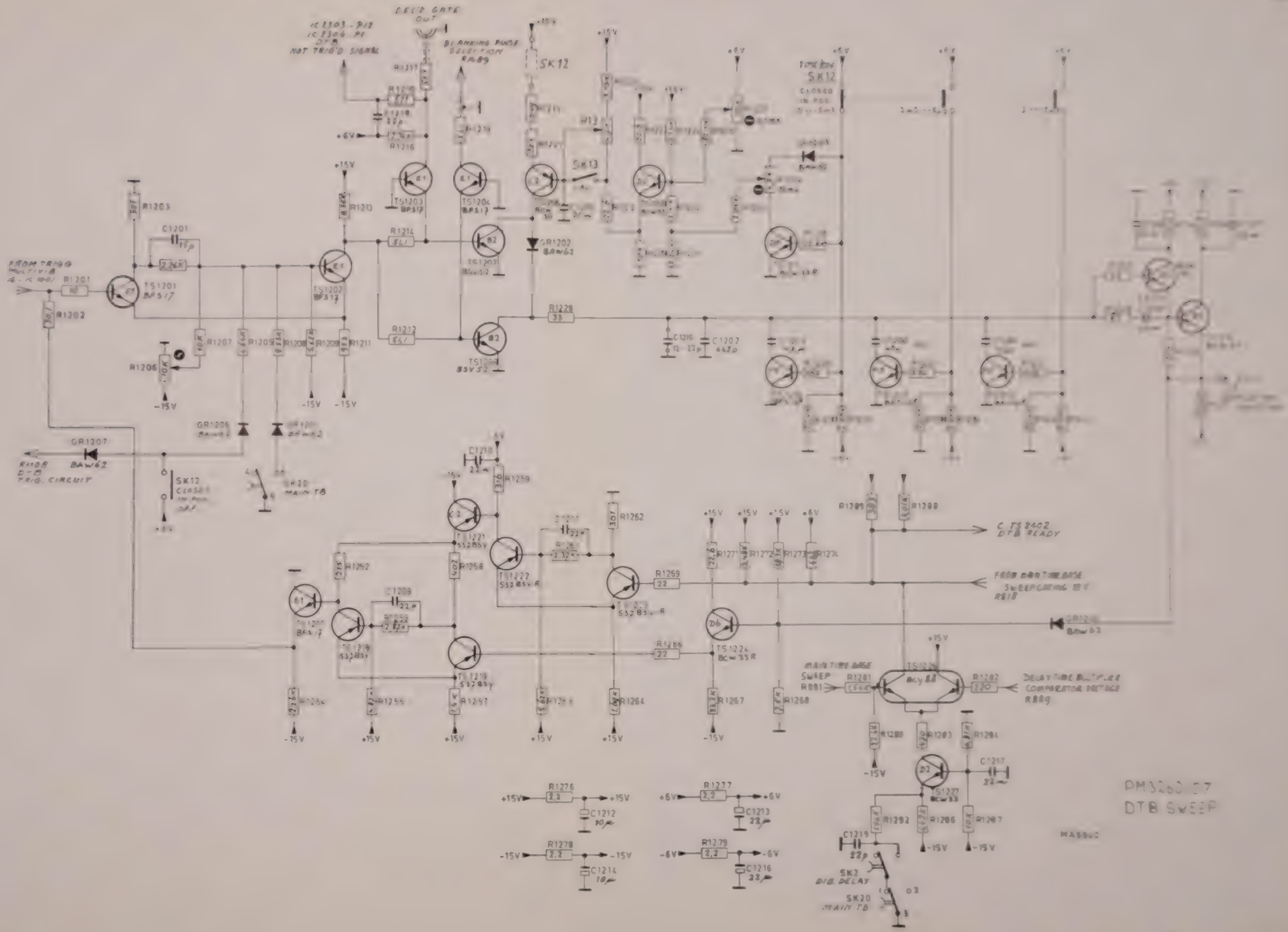

DELD GATE OUT
IC 2303 - Pin 8
IC 2306 Pin 8
DTB
NOT TRIG'D SIGNAL
BLANKING PULSE SELECTION RM89
SK12
SK13
TONE BOX
SK12
R1203
C1201
R1201
R1202
R1206
R1207
R1208
R1209
R1211
R1210
R1213
R1214
R1212
R1228
C1215
C1207
TS1201 BPS17
TS1202 BPS17
TS1203 BPS17
TS1204 BPS17
TS1207 BSW52
GR1202 BAW62
GR1206 BAW62
GR1207 BAW62
FROM TRIG'D MULTIVIB A - K RM81
R1108 D-B TRIG. CIRCUIT
SK12 CLOSED in Pos. OFF
SK20 MAIN TB
C1218
R1259
R1262
R1269
R1252
R1258
C1209
R1254
R1256
R1257
R1264
R1266
R1267
R1268
TS1221 BSV85Y
TS1222 BSV85Y R
TS1223 BSV85Y R
TS1219 BSV85Y
TS1224 BCW33R
R1289
R1288
C TS 2402 DTB READY
FROM MAIN TIME BASE SWEEPCARING III V R813
GR1210 BAW62
MAIN TIME BASE SWEEP R881
R1281
TS1225 BCY88
R1282
DELAY TIME MULTIPLIER COMPARATOR VOLTAGE R889
R1280
R1283
R1284
C1217
TS1227 BCW33
R1292
R1286
R1287
C1219
SK2 DIS. DELAY
SK20 MAIN TB
R1276
C1212
R1278
C1214
R1277
C1213
R1279
C1216
PM3260 07
DTB SWEEP
MA5960

Fig 3.13 D.T.B.

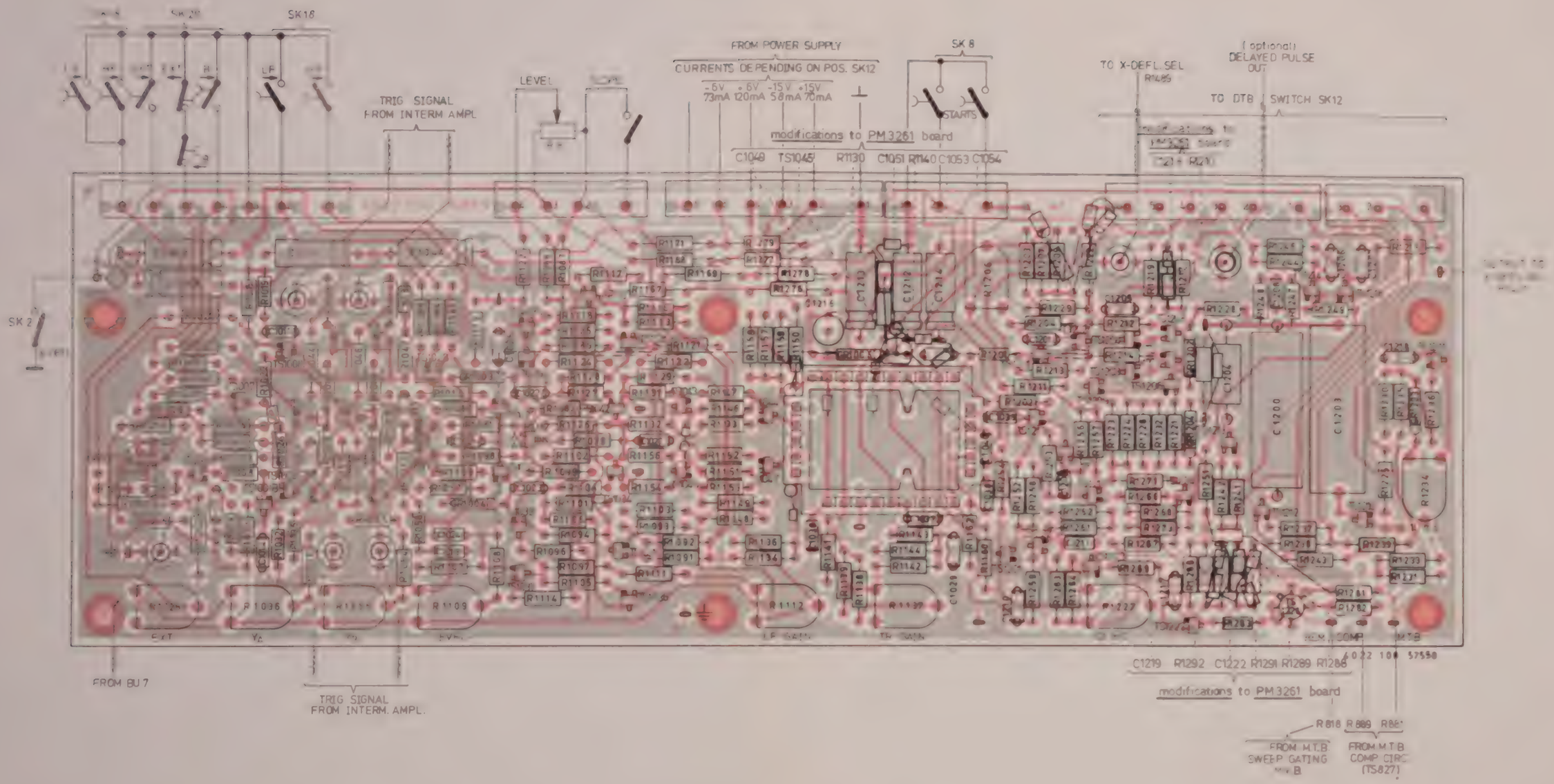


Fig. 3.14. D.T.B. circuit board

CODING SYSTEM OF FAILURE REPORTING FOR QUALITY ASSESSMENT OF T & M INSTRUMENTS

(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

① Country	② Day Month Year	③ Typenumber /Version	④ Factory/Serial no.
3 2	1 5 0 4 7 5	0 P M 3 2 6 0 0 2	D O 0 0 7 8 3

CODED FAILURE DESCRIPTION ⑥

⑤ Nature of call	Location	Component/sequence no.	Category
☐ Installation		T S 0 6 0 7	5
☐ Pre sale repair		R 0 0 6 3 1	2
☐ Preventive maintenance	0 0 2 1	9 9 0 0 0 1	4
☒ Corrective maintenance			
☐ Other			

⑦ *Job completed* ☒

Working time ⑧ ☐☐12 Hrs

Detailed description of the information to be entered in the various boxes:

①Country: 3 2 = Switzerland

②Day Month Year 1 5 0 4 7 5 = 15 April 1975

③Type number/Version O P M 3 2 6 0 0 2 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

④Factory/Serial number D O 0 0 7 8 3 = DO 783 These data are mentioned on the type plate of the instrument

⑤ Nature of call: Enter a cross in the relevant box

⑥ Coded failure description

Location

☐☐☐☐

These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual).

Example: 0001 for Unit 1
000A for Unit A
0075 for item 75

If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

☐☐☐☐☐☐

These six boxes are intended to pinpoint the faulty component.

A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric,the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes.

B. Parts not identified in the circuit diagram:

990000 Unknown/Not applicable
990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002 Knob (incl. dial knob, cap, etc.)
990003 Probe (only if attached to instrument)
990004 Leads and associated plugs
990005 Holder (valve,transistor, fuse, board, etc.)
990006 Complete unit (p.w. board, h.t. unit, etc.)
990007 Accessory (only those without type number)
990008 Documentation (manual, supplement, etc.)
990009 Foreign object
990099 Miscellaneous

Category

☐

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement (of transistor, resistor, etc.)
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

⑦ Job completed: Enter a cross when the job has been completed.

⑧ Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

☐☐12 = 1,2 working hours (1 h 12 min.)

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